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Thomas Squire.

Esquire

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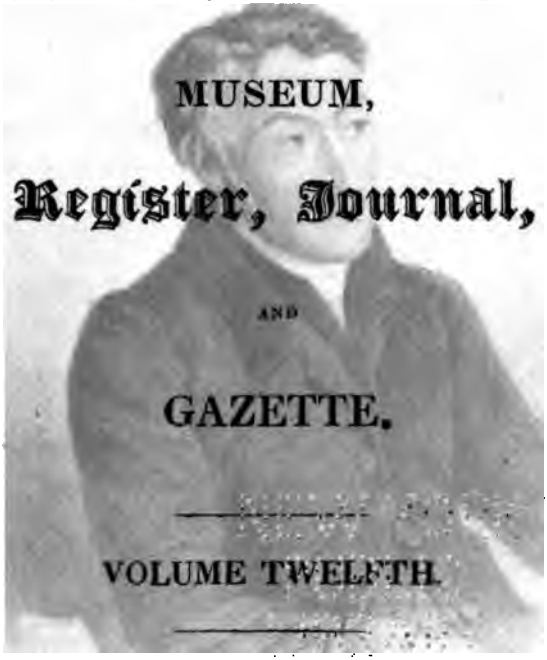
from a Picture Painting by [illegible] Esq. [illegible]

THE

MECHANICS' MAGAZINE,



MUSEUM,

Register, Journal,

AND

GAZETTE.

VOLUME TWELFTH.

"The labouring man, in the present age, if he does but read, has more helps to wisdom than Solomon had."—AMERICAN ALMANAC.

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PREFACE

TO

THE TWELFTH VOLUME.

ALEXANDER THE GREAT is said to have wept because he had no more worlds to conquer. A greater than Alexander —the immortal Newton—though he achieved more than all the conquerors that ever lived, yet sighed to think he had but picked up a few pebbles on the great shore of truth. The melancholy of the Macedonian hero, is happily such as can never have a place in the breasts of those, who look only to have leisure when they have no more to learn. In philosophy there are *always* new worlds to conquer. A limit there will ever be, beyond which the longest sword cannot reach—a period to all glory reaped in fields of blood: but as has been well observed by another illustrious philosopher (over whose early grave the Genius of Discovery yet bends and weeps), "SCIENCE is like that nature of which it treats; it is neither limited to time nor space; and the more we know, the more we feel how much remains to be known."*

When we reflect that our vocation is cast in a sphere thus boundless and inexhaustible, we feel that it would be to boast of little, were we to speak of the Volumes we have numbered, or of the abundance and variety of the matters which they contain. The "MECHANICS' MAGAZINE" is but now entering its teens: while other journals, devoted to similar objects, have had their years of jubilee to celebrate; and some bid fair even to rival the green old age of our learned and much respected friend, "Sylvanus Urban, Gent." But though we may not claim any consideration on the score of either arduous or long service—though we must allow it to be easy to gather, where we have but to stretch forth the sickle and reap, and hard to tire where novelty awaits us at every step—we shall have all the encouragement we desire, if it be only granted, that we have increased in usefulness as we have increased in years, and kept advancing in the estimation of our readers, as we have added Volumes to our series.

* *Discourses of* Sir Humphrey Davy. Discourse IV.

The period over which the present Volume of our journal extends, has been distinguished by occurrences which illustrate remarkably, the propriety of that diffidence of the extent of human knowledge, which those who have penetrated deepest into the mysteries of nature, have always been the readiest to avow. We allude in a special manner to the recent experiments with locomotive-carriages on the Liverpool and Manchester Railway, and to the new and important facts in science which they have been the means of developing. Most writers on locomotion—as well those who have drawn their conclusions from practical observation, as those who have built their faith on theoretical calculation—have treated the notion of travelling on railways by steam, or any other power, at the rate of twelve or fifteen miles an hour, as perfectly chimerical: but the experiments in question have, for the first time, placed beyond all doubt, that at least *double that speed* is attainable with perfect ease and safety. The chief source of the incredulity which has prevailed on this head, has been the existence of very erroneous ideas with respect to the retarding effects of friction, which the same experiments have clearly shown to have been hitherto much exaggerated. It has been calculated by some that friction operates as a resistance to motion on a level railway in the ratio of 12½ lbs. per ton; by others, that it bears only the ratio of 10½ lbs.: but these experiments have established, that by the use of wheels of an improved construction, the friction may be actually reduced to as low as 2½ lbs. per ton. Again: though it was generally allowed that steam-carriages might be propelled on a *level* railway at a considerable velocity, without the help of rack-rails or any other contrivance to prevent the slipping of the wheels, it was as generally maintained that they could not be employed with much useful effect on inclined planes of a greater inclination than 1 in 200; that on a plane of 1 in 96, they would just be able to move their own weight; and that when the ascent reached 1 in 60, they would come to a stand still. Now, it has been farther shown by the experiments to which we refer, that up a plane, such as that on which it was supposed a steam-carriage could just move itself, it can draw with ease three times its own weight, at the rate of, at least, ten miles an hour; or to put the case more popularly, that instead of a feather-weight it can carry fifteen tons, at the rate of ten miles *an hour, or a carriage* with thirty persons at the rate of

twenty. On the head, too, of the cost of locomotive engines, there have been some singularly novel results obtained. The best locomotive engines in use, twelve months ago, were not worked at an expense for fuel of less than one farthing per ton per mile; but by the successful application of a blast to the aid and support of combustion, as exemplified in the patent steam-boiler of Messrs. Braithwaite and Ericsson, it has been ascertained, that the same weight may be conveyed ten times the distance for the same money.

The new light which these various results throw over a wide range of mechanical science, and the vast influence which they must have in increasing the celerity and cheapness of our internal communications, will sufficiently account for the prominent place which they occupy in the following pages. Most of them we have had the pleasure of first making known to the public; and in no other journal have they been described at equal length, or we believe with equal exactness.

It has not unfrequently happened, that where science has left nothing to discover, it has still left much to be done in the way of practical application; and of this also, our present Volume exhibits a striking example in the article entitled "Portable Trigonometry without Logarithms." We have elsewhere described it as worth "apples of gold" to practical men; and the numerous testimonies of its value which we have since received from individuals of that description, convince us that we have not exaggerated its merits.

The hope expressed by the learned (how *eminent* we are not at liberty to say) author of that article, that it might "stimulate some individual of more leisure to turn his attention to the similar abbreviation of a table of logarithms," has, we are happy to say, had the desired effect. Another correspondent of distinguished mathematical attainments, has favoured us with a set of logarithmic tables, which will occupy little more than half a sheet, and will be found to combine in an unrivalled degree practical utility with conciseness. We expected to be able to give it in the same volume that contained the "Portable Trigonometry," but various circumstances have retarded the progress of the manuscript through the press. It will be published in one of our earliest Supplementary Numbers.

The valuable support which we continue to derive from the contributions of liberal and enlightened friends, as evinced

in the instances of which we have just spoken, and more or less in every sheet of our work, demands from us a fresh expression of our warmest thanks.

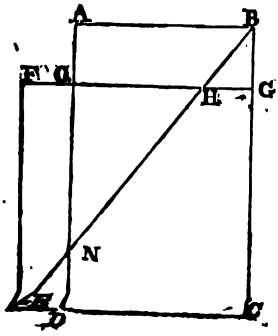
In our selection (p. 411) from the answers received to a mechanical exercise, proposed by Mr. Lucock, and our remarks thereon (p. 412), we have inadvertently done an injustice to an ingenious correspondent, Mr. William Dowling, which we gladly take this opportunity of acknowledging and rectifying. In consequence of our mislaying a solution of the problem with which he favoured us, we had it not before us at the time of making that selection, and were led to award the preference to one of inferior merit. As the best atonement we can make to Mr. Dowling, we subjoin his letter of remonstrance and the solution referred to, which we freely admit to be not only more simple than that of our ingenious young friend, Mr. Hughes, but in every respect superior; it being as it appears to us of universal application, while cases may be readily imagined where Mr. Hughes' mode of solution would not apply.

115, Fleet-street, Feb. 27, 1830. J. C. R.

MR. LUCOCK'S MECHANICAL PROBLEM.

Sir,—About a month since I transmitted you a solution of Mr. Lucock's Mathematical Problem, the receipt of which was acknowledged in the subsequent Number of the Magazine. I was therefore somewhat surprised on perusing the Magazine of this day, to find that amongst the various solutions of the before-mentioned problem, you had omitted to mention that sent by me. I should not have thought it worth while to notice this circumstance, had it not been for one part of the concluding observations, which states that of all the solutions received, that of the proposer not excepted, the solution of Mr. Thomas Hughes is by far the neatest and best, as it is effected with the fewest lines. Now, in my solution (of which the following is a copy) the *first* line I draw, solves the problem, and it is therefore, I think, equally simple if not more so than that of Mr. H.; and as it is the solution of a *mechanic*, is perhaps as much entitled to a place in the MECHANICS' MAGAZINE. *Quod dicitur nostrum est et nobis.*—I am, Sir, yours respectfully,

30th January, 1830. WILLIAM DOWLING.



Let ABCD be the rectangle, equal to the required square FGCE. Join BE by a right line cutting FG, AD in H and N; then because EF=CE we shall have (by similar triangles) FE:CB :: AB : AN, whence FE·AN = CB·AB. But CB·AB=FE² by hypothesis, therefore AN=FE, and consequently ND=BG; hence (Euclid 1,26) the triangles ABN, GBH in the rectangle, are equal and similar to the triangles FHE, DNE, in the square, and the part DNHGC is common to both.

LIST OF NEW PATENTS.

Continued from the 21st of August, 1829, (see p. 96) to the 27th of February, 1830.

G. H. Manton, of Dover-street, Piccadilly, for an improvement in the construction of locks for fire-arms. Dated 2nd September. Specification to be enrolled in two months.

J. Tucker, of Hammersmith, for certain improvements in the construction of cannon. 9th September. Six months.

T. S. Brandreth, Esq. of Liverpool, for a new method or methods of applying animal power to machinery. 9th September. Six months.

J. A. Fonzi, Esq. of Upper Mary-le-bone-street, for certain improvements on, or additions to, fire-places. 9th September. Six months.

J. Soames, jun. of Wheeler-street, Spitalfields, for a new preparation or manufacture of a certain material produced from a vegetable substance, and the application thereof to the purposes of supplying light. 9th September. Six months.

T. Morgan, of Tipton, for a new method of manufacturing or preparing iron plate. 9th September. Six months.

R. Torrens, of Croydon, for certain apparatus for the purpose of communicating power and motion. 9th September. Six months.

D. Lawrence, of Strood, and J. Crundwell, of Ashford, for certain improvements in apparatus to be applied to fowling-pieces, and other fire-arms. 15th September. Six months.

G. Harris, R.N. of Brompton Crescent, Middlesex, for improvements in the manufacture of ropes, cordage, canvas, &c. 15th September. Six months.

John Milne, Edinburgh, for a machine or engine for dressing of stones. 15th September. Six months.

Jas. Atchison, Clyde-buildings, Glasgow, for certain improvements in the concentrating and evaporating of cane-juice, &c. 15th September. Six months.

Thomas Cobb, Esq. Calthorpe-house, Oxford, for certain improvements in the manufacture of paper for hanging rooms, &c. 15th September. Six months.

T. Westwood, of Princes-street, Leicester-square, for certain improvements in watches and time-keepers. 23rd September. Six months.

I. Brown, of Gloucester-street, Clerkenwell, for certain improvements applicable to watches. 23rd September. Two months.

H. Tyler, of Warwick-lane, for certain improvements in the construction of water-closets. 23rd September. Two months.

J. Moore, of Broad Wier, Bristol, for certain new or improved machinery for propelling carriages, ships, or other floating bodies, &c. 30th September. Six months.

W. Roger, of Norfolk-street, Strand, for certain improvements in the construction of cat-head stoppers. 30th September. Six months.

T. Banks, of Patricroft, within Barton-upon-Irwell, Lancaster, for improvements in steam-engines. 30th September. Six months.

P. Descroizelles, of Fenchurch-street, for certain improvements in apparatus for removing the down from cotton and certain other fabrics, by singeing. 7th October. Six months.

W. Church, Esq. of Heywood-house, Birmingham, for certain improvements in machines for propelling vessels, &c. 15th October. Six months.

W. Church, Esq. of Heywood-house, Birmingham, for improvements in sharpening knives and other edge-tools. 15th October. Six months.

T. J. Fuller, of the Commercial-road, Limehouse, civil engineer, for an improved mechanical power applicable to machinery of different descriptions. 28th October. Six months.

G. Danre, of Birmingham, manufacturer, for a self-acting air or gas regulator, which may be applied to other purposes. 2nd November. Six months.

J. M'Curdy, of Great James-street, Bedford-row, gentleman, for certain improvements in the method of constructing mills and mill-stones for grinding. Communicated by a foreigner. 2nd November. Two months.

J. Viney, of Piccadilly, colonel in the royal artillery, for certain improvements in steam-boilers, &c. 2nd November. Six months.

J. Soames, jun. of Wheeler-street, Spitalfields, soap-maker, for a new preparation or manufacture of a certain material produced from vegetable substance, and the application thereof to the purposes of affording light. 2nd November. Six months.

J. Tucker, of Hammersmith, brewer, for an exploding shot or projectile. 2nd November. Six months.

J. Stewart, of George-street, Euston-square, piano-forte maker, for certain improvements on piano-fortes. 2nd November. Two months.

J. Cowderoy, of Britannia-street, City-road, gentleman, for certain improvements in machinery for making bricks. 2nd November. Six months.

F. Nash, of Stoneason, near Wells, gentleman, for certain improvements in the manufacture or application of silks mixed or combined with other articles. 2nd November. Two months.

W. Gooch, of Mount-street, Berkley-square, for certain improvements on baths of different descriptions. 7th November. Six months.

D. Macdougall, of Edinburgh, horticulturist, for certain improvements on or additions to syringes applicable to garden and other purposes. 10th November. Six months.

T. Osler, of Birmingham, chandelier manufacturer, for certain new improvements in the construction of glass and metal chandeliers. 10th November. Six months.

J. Gibbs, of Crayford-mills, timber-merchant, for improvements in machinery for cutting marble, wood, and other substances. 12th November. Six months.

J. Dodgson, of Lower Shadwell, pump and engine maker, for certain improvements in ships' scuppers. 17th November. Six months.

W. Clutterbuck, of Oylebrook, near Stroud, for certain improvements in the shears used for cutting or cropping of woollen cloth and other fabrics requiring shearing. 21st November. Two months.

T. Gethen, of Furnival's Inn, gentleman, for certain improvements in dressing woollen cloths. 21st November. Six months.

W. Hale, of Colchester, for a machine or method of raising or forcing water for propelling vessels. 12th January. Six months.

J. Carpenter, Willenhall, Stafford, and J. Young, Wolverhampton, for certain improvements on locks, and other securities, applicable to doors and other purposes. 18th January. Six months.

W. Parr, of City-road, for a new method of producing a reciprocating action by means of rotary motion, to be applied to the working of all kinds of pumps, mangles, and all other machinery in or to which a reciprocating action is required or may be applied. 13th January. Four months.

E. Dakeyne and J. Dakeyne, Derby, for a machine or hydraulic engine for applying the power or pressure of water, steam, and other elastic fluids to the purpose of working machinery, &c. 21st January. Six months.

G. Vaughan, Mile-end-road, engineer, for a machine or pump for raising water or other fluids. 23rd January. Two months.

John Yates, of Hyde, Chester, calico-printer, for a method or process of giving a metallic surface to cotton, silk, linen, and other fabrics. 26th January. Six months.

G. Stocker and A. Stocker, Yeovil, Somerset, gunsmiths, for a cock for drawing liquor from casks, which produces a stop superior to that which is effected by common cocks, and will continue in use for a longer period of time. 26th January. Two months.

J. Arnold, of Sheffield, York, powder-flask maker, for an improved spring-latch or fastening for doors. 26th January. Two months.

G. F. Johnson, of Canterbury, Kent, Tunbridge-ware manufacturer, for a machine or apparatus, which is intended as a substitute for drags for carriage-wheels, &c. 26th January. Six months.

T. Bulkeley, of Richmond, Surrey, doctor of physic, for a method of making or manufacturing candles. 26th Jan. Six months.

J. Cobbing, of Bury St. Edmund's, cord-wainer, for certain improvements on skates. 26th January. Six months.

S. Wright, of Shelton, Staffordshire Potteries, for manufacture of ornamental tiles, bricks, and quarries, for floors, pavements, and other purposes. 26th January. Six months.

R. Busk, of Leeds, gentleman, for certain improvements in apparatus used for distilling and rectifying. Communicated by a foreigner. 26th January. Six months.

J. Revere, of New York, United States of America, but now of St. James's, Westminster, M. D., for a new alloy or compound metal applicable to the sheathing of ships, &c. 28th January. Six months.

Josias Lambert, of Liverpool-street, London, Esq., for an improvement in the process of making iron applicable at the smelting of the ore, &c. 4th February. Two months.

G. Pocock, of Bristol, gentleman, for improvements in making or constructing globes for astronomical, geographical, and other purposes. 4th February. Two months.

J. Gray, of Beaumaris, Anglesea, gentleman, for a new and improved method of preparing and putting on copper sheathing for shipping. 4th February. Two months.

T. Miller, of Piccadilly, Middlesex, wax-chandler, for an improvement in making candles. 4th February. Six months.

J. C. Daniell, of Limpley Stoke, Wilts, clothier, for improvements in manufacturing woollen cloths. 4th February. Six months.

M. Wilson, Warnford-court, London, merchant, for an improved method of cleaning rough rice. 6th February. Six months.

T. R. Williams, of Nelson-square, Surrey, Esq., for improvements in power looms for weaving wire. 6th February. Six months.

E. Cooper, of Streatham Place, Surrey, gentleman, for improvements in making gas. 12th February. Six months.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

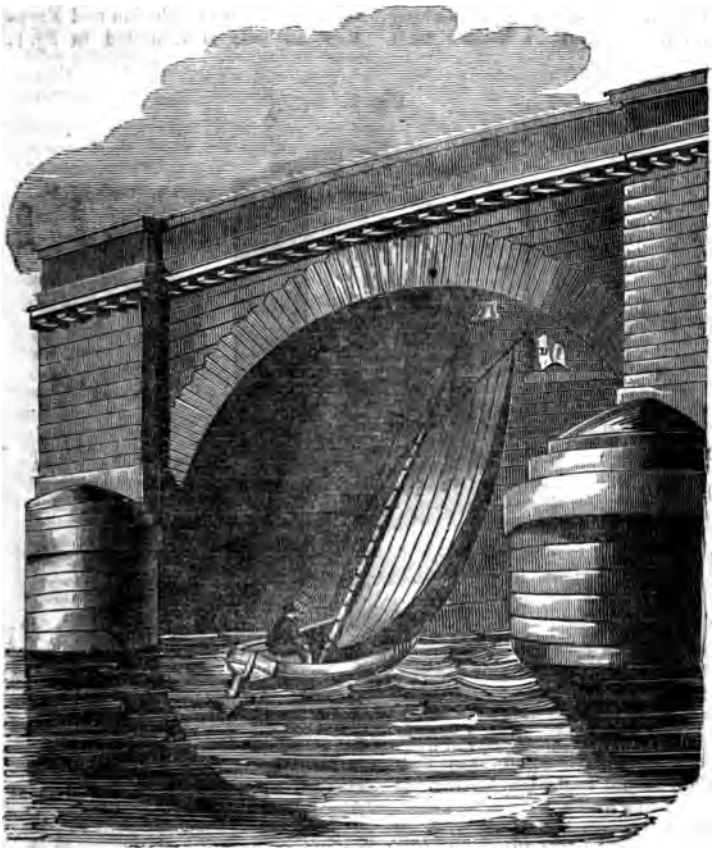
No. 316.] SATURDAY, AUGUST 29, 1829. [Price 3d.

——————— "Then men
Observe the strength, the height,—the why and when
It was erected: and still passing under,
Meet some new matter to look up and wonder."

CHURCHILL.

NEW LONDON BRIDGE.

CENTRE ARCH.



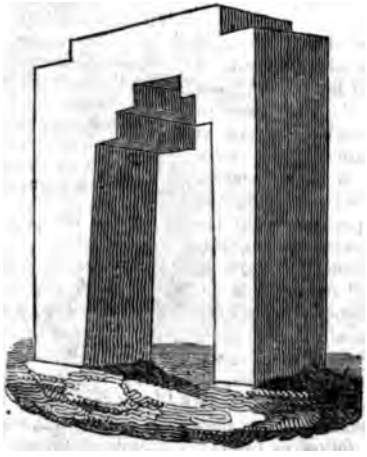
A DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES.

BY MR. CHRISTOPHER DAVY, ARCHITECT.

No. I.

The invention of the arch marked a great era in architecture, it being the only important addition which was made to this science for several centuries after the introduction of the Grecian orders. It formed the chief source of the excellence of the Roman or Italian style, giving birth to those "aspiring arcades" for which the Italian palaces are so distinguished. But though the invention of the arch was thus important, its origin is involved in great obscurity. Almost every writer on the subject gives a different account of the matter; and, after all that has been said, we as yet know nothing certain regarding it. I believe most parties agree on one point, viz. that the Babylonians were well acquainted with the properties of the arch. Now, there seems to be a great difficulty in reconciling this supposition with the remains of structures said to be of Babylonish origin; for in them no specimen of a correct arch has yet been discovered. The bridge over the Euphrates had the intervals between the piers covered with planks and squared beams, which were removed at night to prevent depredations (this is supposed to be the earliest specimen of a draw-bridge). It is plain, therefore, that arches could not have been turned between the piers. Besides, had they been arched, it is scarcely possible that the arches could have decayed so soon and left the piers standing. An early attempt to increase the height of an opening by the Babylonian and Egyptian methods is exhibited in fig. 1.

Fig. 1.

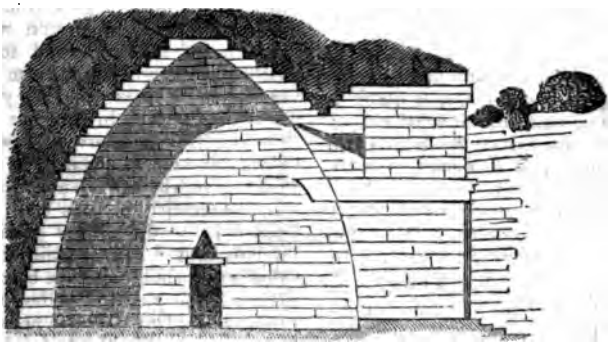


The masonry, to use a technical phrase, was here *oversailed* one or more courses, and the jambs approached each other towards the top.

The Nubians, Chinese, and others, appear to have nearly equal claims with the Babylonians to the employment of such arch-like forms.

The rudest attempt at an arch of uniform curvature was, no doubt, caused by excavating rock or earth of a firm texture. An instance may be seen, in fig. 2, of probably the first attempt at a curvilinear form, by means of separate stones artificially combined, discovered at Mycenæ, in the plain of Argolis.

Fig. 2.



This singular relic of antiquity is called the subterraneous chamber of the treasury of Atreus. The ornaments of this building exhibit also the earliest specimens of Greek sculpture, and may be consulted by students with advantage in the Elgin gallery at the British Museum.

By reference to the sketch, fig. 2, it will be seen that the chamber was of a parabolic form; but the construction was so deficient in the principles of the arch, that it appears to be one of those straws that antiquarians have been eager to grasp at to set contention at rest. I beg leave to refer the curious for farther particulars to the very interesting description of this building by Donaldson, in Parts 3, 4, and 5 of Stuart's "Athens."

Architecture has benefited not only from the introduction of the arch in its most simple form, but from a great variety of delightful combinations, all emanating from a knowledge of its properties. These combinations may be classed under the following heads:

Varieties of the Italian Style.

1. The archoid, or arch vault.
2. Domoid, or dome.
3. Polygonal ditto.
4. Conoidal ditto, or circular.
5. Pendentoids—when used internally, called a *vellar cupola*.
6. Groinoids, or groins.
7. Lunoid, or Welsh groins.
8. Lunetted domoid.

The following come under the general denomination of "Old English," or Gothic.

9. Pointed arch.
10. Quadrilateral pointed groined vault.
11. Octagonal ditto ditto.
12. Pointed groined rib vault, upon a rectangular plan.
13. Pendant rib ridged vault, upon a square plan.
14. Rib truncated vault, square plan.
15. Pendant rib truncated vault, oblong plan.
16. Octagonal dome groined vault, with pointed arches.
17. Circular dome groined rib vault, with pointed arches.

From the preceding enumeration of the varieties of arches and vaulting, it is evident that our ancestors went far before any others in the degree of perfection to which they carried the principles of their construction. In the different varieties of the pendentoid, huge masses of stone were absolutely *suspended* instead of supported; and in groining, it would appear as if the points of support dwindled into slender shafts, apparently incapable of supporting a tithe of the superincumbent weight.

The more curious of the forms specified in the above will be found exemplified in the following structures:—

The *polygonal*, on a square plan—in the British Museum, Holkham Hall, &c.
The *conoidal*—in St. Paul's, and St. Peter's, Walbrook.
The *pendentoids*—in the nave and aisles

of St. Paul's, and many public buildings, particularly by Soane.

The *groins* — in Somerset House, lateral passages of the Custom House, Horse Guards, wine-cellar stores at the various docks, &c.

The *lunoid* — Fletcher's late chapel, Finsbury, and many churches.

The *pendant rib truncated vault*, oblong plan — in the chapel of Henry VII., Westminster, and King's College Chapel, Cambridge.

The *octagonal pointed groined vault* — in most of the Chapter-houses of the British Cathedrals.

The *quadrilateral pointed groined vault* — common in churches and cathedrals in the Gothic style; St. George's Chapel, Windsor; Cloisters, Westminster Abbey.

The particular subject on which I am about to treat will involve the most simple of these forms only—the archway — the extrados and intrados of the same, together with the abutments and roussoirs, &c. &c.

(To be continued.)

A CHEAP AND SPEEDY PLAN FOR INCREASING THE POWER OF ARTILLERY, WITHOUT MAKING ANY CHANGE UPON THE GUNS, AND WITH A GREAT SAVING OF POWDER.

BY MR. JOHN ANDERSON, A.M.
Professor of Nat. Phil. Glasgow.

[The following interesting paper on gunnery, by the celebrated Professor Anderson, of Glasgow, is printed from the original manuscript, in the handwriting of the author, and is now published, we believe, for the first time. It bears the date of 1782, and appears to have been submitted to the Board of Ordnance, which was at that time under the direction of the Duke of Richmond. The professor is known to have considered himself ill-used by the duke; and it is not improbable that inattention to this memoir may have been one of his causes of complaint. It is but fair, however, to add, that with regard to the chief improvement which it is the purpose of this paper to recommend, namely, the adoption of shot of a spheroidal form — that subsequent experiments have shewn that it would be *no* improvement. In an unpublished work by Colonel Macerone, from which we lately made some interesting extracts on rifles, there is the following remark on this subject: "It has been often imagined to construct bullets of the shape of an egg or a pear, on the supposition that the bigger or heavier end would steadily preserve the foremost position during the flight; and that, as the whole bullet, although one-third or one-fourth heavier, would afford no more superficies to the resistance of the air than a sphere of the same calibre, its range would be considerably greater. Experience, however, proves this to be erroneous; for this egg-shaped bullet, upon its exit from the barrel, whirls over and over during so great a portion of its flight, as greatly to increase instead of diminishing the surface of resistance, by which its range is not only curtailed but considerably disordered."—Ed.]

After all the books that have been written by men of science concerning projectiles, and all the experiments that have been made by artillerists of the greatest merit, the gunner's art is still very imperfect: for if discharges are made from the same gun, and with the powder, ball, wadding, heat, weather, and all circumstances as much alike as they can be made by the ablest practitioners, yet the balls are thrown to distances that differ from each other by hundreds of yards; and their deviations from the line of direction are many degrees, if we reckon the muzzle of the gun the centre of a circle.

In support of this assertion, I need not bring the many experiments which I have lately made. It is proved, in the clearest manner, by the writings on artillery of the best practitioners in every country of Europe. A twenty-four pounder, says Robins, vol. i. p. 300, when elevated to seven degrees and a quarter, and charged each time with the same quantity of powder, threw one shot 2300 yards, and the very next shot to more than 3000 yards. And I have seen, says he, page 251, a piece fired with great care in an invariable position, and yet two successive shots of it have flown

in directions which, on the horizontal plane, made an angle with each other of above fifteen degrees.

The experiments of the ablest foreign artillerists prove the same thing; but they need not be quoted in this place, as many of them are to be found in the Posthumous Works of Robins, who surpassed every writer on this subject in force of genius and accuracy of practice.

These vast irregularities in the paths of military projectiles are produced by four causes, the windage, the wadding, the rotation of the ball in the gun, and the resistance of the air through which it moves in its flight.

If the ball fits the bore of the gun with perfect accuracy, its centre will coincide with the axis of the gun, and the direction of the ball will be that of the gun. Such accuracy does not take place in common practice, on account of the inequalities which the balls get when they are formed in the mould, and which both the balls and the bore contract from rust and filth. This difference between the diameter of the ball and the bore of the gun is called the windage; and it is not less sometimes than four-tenths of an inch. If the ball always rubbed against the lowest part of the bore, it would be discharged lower than the direction of the gun; and this, though an error, would be invariably the same, and, therefore, would cease to be an error, because it would be known. As, however, the ball may, on account of the windage, rub a different part of the bore at every discharge, hence the path of its centre cannot be known. This is an inconsiderable circumstance: were balls always globes, as the word imports,—but it is well known that they are not so,—and if the ball, improperly so called, has a flat part upon its surface, and touches the edge or outmost circle of the bore when it leaves the gun, it will deviate to that side; or if it has a protuberance, it will deviate to the contrary side. Now every one knows that an error of the tenth part of an inch at the muzzle of the gun will make a deviation of many yards at the distance of a mile.

Wadding is necessary in order to compress the powder when put into the gun, and to *hinder it from* escaping by the windage, when, by fire, it is converted into an elastic fluid, like steam. It is commonly made of the yarn or threads of old ropes, wound into balls, which differ in the closeness of their texture and the firmness with which they are rammed; in consequence of which, the same quantity of the fired powder does not enter into their vacuities, and the balls are not always equally impelled by it upon the same parts; and hence the line of their deviations will not always be the same.

The rotatory motion of the ball, or its whirling round its axis, by rubbing against the bore of the gun, makes it strike against the bore and the air differently from what it would do if it had no other but a progressive motion: and as this must be different in different balls, for the reasons that have been mentioned under windage and wadding, hence the deviations arising from this cause will scarcely ever be the same.

Every one may understand this motion by looking at that of the marbles with which boys play. Sometimes a marble, when projected, has only a progressive motion; and at other times it has likewise a revolution round its axis by rubbing on the ground. This second motion is sometimes in the direction of the first, sometimes in lines that make different angles with it, and sometimes in a line that is directly contrary. Hence it is that sometimes when the marble has moved forward in a straight line it suddenly returns directly backward, because the second motion has overcome the first. And hence, if cannon balls receive a rotatory motion from their friction in the gun, and if that friction is different in different balls, for the reasons already given, this will be a third cause that will vary the angle of their deviation. The resistance of the air is the greatest cause of uncertainty in the flight of military projectiles, and yet it was considered, by the ablest philosophers and most accurate artillerists, as altogether inconsiderable, till about forty years ago, when Robins first shewed that if a twenty-four pound ball is impelled by its usual charge, the opposition of the air to its motion is equal to a weight of at least 400 lbs.; that this resistance continually dimi-

nishes its velocity; that if it is impelled at an elevation of forty-five degrees, its range, or the distance to which it will go, is not a fifth part of what it would be, could the air be entirely removed; that the swifter it moves, the greater will be the resistance of the air: and, according to this law, with a double velocity it will be four times greater; with a triple, nine times; with a quadruple, sixteen times, and so on; but when the velocity is greater than 1200 feet in a second of time, then a new law takes place, for it is three times greater;* that, in consequence of this immense resistance of the air, an increase of the initial velocity of a ball does not make a proportional increase of its range; that, as there is a great resistance in the front of the ball, less at the sides, and a vacuum behind, it will deviate to a side where the opposition is least, till it condenses the air in its new path as before, and thus it goes zig-zag in its flight; that, in consequence of this prodigious resistance, and which is very different with different degrees of velocity, many of the irregularities in the flight of balls may be explained, though the causes in particular cases cannot be ascertained.

Did we not know from history the slowness of man in making discoveries in every science, it would appear astonishing how both theorists and practitioners should have supposed that the resistance of the air to military projectiles was so inconsiderable as to deserve no attention; when every boy knows, that if he runs forward with his windmill, in the calmest day, it will turn round as if there were a strong wind; or if he gallops his horse, he feels a resistance from the air that is very great, though the velocity with which he moves is not the twentieth part of that of a cannon-ball.

When I considered how to remove, or to diminish, these disturbing causes of the regular flight of military projectiles, and how to increase their power in such a manner as to be useful in war, I saw, after many theories, and a variety of experiments which would fill a volume, that nothing of importance could be done with balls, and therefore I fixed upon a shot of a different kind. It is a spheroid, but a part of it over the lesser axis is a cylinder; it is double the weight of a ball of the same matter that fits the same gun; it is impelled by common powder, a bladder called an addition, and a wadding that is uniform and hard. This cheap and simple contrivance seems to be a great improvement in artillery; and for the following reasons:—

1st, As the cylindrical part of this shot is made to fit the bore very nearly, its centre will coincide almost with the axis of the gun, by which means there will hardly be any windage, and, consequently, none of the causes of deviation that arise from it.

2dly, The wadding will have three properties: it will be impenetrable to the fired powder—it will allow very little or none of it to escape—and it will always impel the shot in the same way. Consequently, it will remove, or it will diminish, the irregularities which common waddings produce.

3dly, As part of this shot is a true cylinder, and nearly as large as the bore, it is impossible that it can revolve like a ball in the direction of the gun; and, therefore, if this is a cause of irregularity in the flight of balls, it is totally removed. If it should revolve lengthwise, that is, upon the axis of the gun, this will be an advantage, like that which arises from rifled musket-barrels, or the feathers upon arrows and shuttlecocks, by which their deviations are greatly diminished.

* Dr. Hutton has denied the correctness of this statement. He says: "Instead of leaping at once from the law of the square of the velocities, and ever after being about three times as much, my experiments prove that the increase of the resistance above the law of the square of the velocity takes place at first in the smallest motions, and increases gradually more and more to a certain point, but never rises so high as to be three times that quantity, after which it decreases again." Dr. H. adds a table of the actual quantities of resistances, deduced from accurate experiments with a ball of 1·965 inches diameter. From this it appears, that at a velocity of 1000 feet, the resistance was = 350 ounces, at a velocity of 1200 = 546, at 1400 = 786, at 1800 = 1319, &c.—Ed.

4thly, The resistance of the air, it is obvious, cannot be destroyed altogether; but it will be lessened in some degree by this shot, and for two reasons:—It is proved by natural philosophers, that if a solid has a spheroidical form, its resistance from the fluid in which it moves is the least possible: and all other circumstances being equal, it will have a greater advantage in overcoming the resistance from a greater quantity of matter.

It is well known to the mathematician, that the surfaces of balls increase according to the squares of their diameters, but the quantities of matter according to the cubes; and to the artillerist, that the range of balls increase with their weights, if their surfaces are the same, or if their surfaces are in a less proportion than their quantities of matter. Thus, for instance, if there are three balls of wood, iron, and lead, of the same diameter, the range of the first will be less than that of the second, that of the second than that of the third, if the velocities given to them are equal. And a thirty-two pound ball of iron, the diameter of which is a little more than six inches, will range nearly half as far again as a nine-pound ball of iron, the diameter of which is four inches, if both are thrown at an angle of forty-five degrees, and if the charge of each is two-thirds of the weight of the ball.

[An account of experiments made by Professor Anderson, at Dumbarton Castle, in consequence of the above theory, will be given in our next.]

REMARKS ON MR. TAYLOR'S DEVELOPEMENT OF CERTAIN NEW PROPERTIES OF NUMBERS.

Sir,—Mr. T. in his first proposition (No. 313) attempts to prove that in every circulating decimal* the sum of the digits of the circulator will be 9. This proposition, according to the examples he has given, should have been enunciated thus: The sum of the digits of the circulator will be 9, or a multiple of 9. Mr. T. gives four examples, in each of which the above property holds good; he has, therefore, concluded that the law is invariable. But this is far from being true. For $\frac{1}{37}$ expanded into a decimal will produce the pure circulate ·015873, 015873, &c. the sum of whose digits is 24; or $\frac{1}{33} = ·03, 03,$ &c. the sum of whose digits is 3. In short, thousands of examples might be given to prove that Mr. T.'s first proposition is only partially true. But in order to see exactly when it holds good and when it fails, we shall first suppose the circle to consist of two figures, then, by the nature of pure circulates, $\frac{1}{99}, \frac{2}{99}, \frac{3}{99}, \frac{4}{99},$ &c. to $\frac{98}{99}$, will express the fractions from which all possible pure circulates, consisting each of two figures, can be derived, and they will be ·01, ·02, ·03, ·04, &c. to ·98. Now the first of these circulates that is divisible by 9 is ·09, the next ·18, ∴ of 98 circulates, each consisting of two places, $\frac{98}{9} = 10$, will be the sum of all the possible pure circulates of two places, the sum of whose digits is divisible by 9, and these fractions, in their lowest terms, will be $\frac{1}{11}, \frac{2}{11}, \frac{3}{11},$ &c. to $\frac{10}{11}$ ∴ when the circulate consists of two places of figures, Mr. T.'s theory only holds good in ten cases and fails in 88. Exactly in the same way it may be demonstrated that when the circulator consists of three figures, Mr. T.'s theory will hold good in 110 cases and fail in 888;* or, in general, let n be the number of figures in the circulator, then 1111, &c. repeated $n - 1$ times, with a cipher annexed, will be the number of times the different circulates can be divisible by 9; and 8888, &c. repeated n times will express the sum of all the circulates that are not divisible by 9.

Mr. Taylor's second proposition is really not new; it is evidently only a particular case of the rule given by several writers on arithmetic for proving division of integers by casting out the 9's, &c.

The first part of Mr. T.'s third proposition is evidently the same as that which was first proposed in the "Mechanics' Magazine" by Mr. Hall, of Manchester; the only difference is, Mr. Hall said the remainder is di-

* Mr. T. here means pure circulates, that is, when the regular succession goes on from the beginning.

* In this and all the subsequent cases, pure repeaters both for and against are included.

visible by 9, and Mr. T. says the sum of the digits is 9, or (he should have added) a multiple of 9. Now it is well known that when the sum of the digits of any number is divisible by 9, the number itself is divisible by 9. In the second part of the same proposition, he adds, "And the same will be found to take place when the order of the terms is irregularly changed;" but this was previously demonstrated to be true by your able correspondent Q. C. F. No. 287, page 446. The last part of the proposition, which is new, as far as I know, may be proved to be universally true, as follows. Let x be any number consisting of any number of figures, and y a number consisting of the same number of figures, in an inverted order, or the digits placed in any order whatever also. Suppose x greater than y, and let m be any integral number, then $x^m - y^m$ will always be divisible by 9. For by O. C. F.'s demonstration, as above quoted, $x - y$ will always be divisible by 9, and $x^m - y^m = x^{m-1}y + x^{m-2}y^2 + x^{m-3}y^3 +$ &c. to y^{m-1}; and since one of the factors is divisible by 9, their product $x^m - y^m$ will also be divisible by 9.

I am, Sir, &c. G. S.

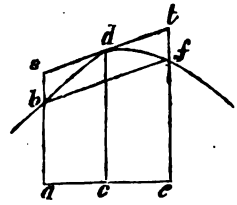
EQUIDISTANT ORDINATE METHOD.

Sir,—One of your correspondents expressed a wish, a few weeks ago, to see, in your excellent Magazine, an investigation of this method, upon simple and obvious principles. I have waited some time, under the hope that some of the more scientific contributors to your pages would execute the desired task; but as nothing to this end seems yet to have been offered to your notice, I beg leave to present the following.*

Your correspondent seems to wish for something less recondite and elaborate than the elegant method exhibited by Dr. Hutton in his "Mensuration;" something which shall be convincing to those, probably, whose theoretic knowledge does not extend beyond the principles of conic sections; and this is now attempted.

* Since the receipt of this paper, we have received another excellent one on the subject from S. S., to which we shall also give a place in an early Number.—Ed.

Lemma.



Let *ab cd ef* be three equidistant diameters of a parabola, and let them be cut at right angles by the straight line *ace*: then the area of the space *abdfea*, comprehended between the curve *bdf* and the straight lines *ba ae ef*, is $= (ab + 4cd + ef) \times \frac{1}{3}\, ac$.

For, drawing through *d* the tangent *st* parallel to the double ordinate *bf*, it is well known (see Hutton's Course, Parabola, th. 16,) that the parabolic space *bfd* is $\frac{2}{3}$ of the parallelogram *bfts*. Now, area of the trapezoid *aets* $= (as + et)\, ac = 2dc \,.\, ac$ (Hutton, Parab. th. 11). And, area of the trapezoid *aefb* $= (ab + ef)\, ac$. Therefore, area *aefb* + 2 area *aets* $= (4dc + ab + ef)\, ac$. But, area *aefb* + 2 area *aets* $= 3$ area *aefb* + 2 area *bfts* $= 3$ area *aefb* + 3 parabolic area *bdf* (Hutton, th. 16) $= 3$ mixtilineal area *abdfea*.

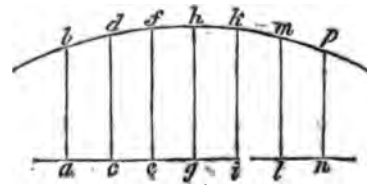
Or, area *abdfea* $= (ab + 4dc + ef)\, \frac{1}{3}\, ac$.—Q. E. D.

The demonstration, conducted upon the same principles, would have led to the same result, if the curve *bdf* had presented its convexity to *ac*.

We may proceed to the

General Proposition.

Let *bdfhkmp* be a continuous and not very irregular curve, presenting either its concavity or its convexity to a right line *an*: let *ab pn* be ordinates drawn perpendicularly from *an* to meet the curve; it is proposed to measure the plane surface *anpm*, &c. *db* by the method of equidistant ordinates.



Let the base *an* be divided into an even number (as 6, 8, 10, &c.) of equal parts, and let parallel ordinates *cd*, *ef*, &c. be drawn at the several points of division. Then, by the lemma, supposing the portions of the curve to be nearly parabolic;—

Area $acfdb = (ab + 4dc + ef) \frac{1}{3} ac$:
Area $cikhf = (ef + 4gh + ik) \frac{1}{3} ac$:
Area $inpmk = (ik + 4lm + np) \frac{1}{3} ac$:

Consequently, by adding together these three equations, area *anpm*, &c. $db = (ab + 4dc + 2ef + 4gh + 2ik + 4lm + np) \frac{1}{3} ac$.—Q. E. F.

Hence, if *f* and *l* denote the first and last ordinates; *e* the sum of the *even* ordinates, as of the 2d, 4th, 6th, 8th, &c.; *o* the sum of the *odd* ordinates, as of the 3d, 5th, 7th, &c., not reckoning in them *f* and *l*; *d* distance between two succeeding ordinates; we shall have—Area *anpm* &c. $db = \frac{1}{3} d (f + l + 4e + 2o)$. This agrees with Rule 4, p. 86, Mensuration of Surfaces, in "Emerson's Course of Mathematics," given there without demonstration; also with the rule at p. 201, Gregory's "Mathematics for Practical Men," given there also without demonstration.

Yet this, after all, it will be remembered, is but an approximation; though, when employed under proper restrictions, a very correct and useful one. Its application to the mensuration of solids may, perhaps, be resumed at a convenient opportunity.

I am, Mr. Editor,
Yours, &c. P. M. W.

[P. M. W., after he had forwarded to us the preceding letter, happening to turn to Part IV. of *Hutton's Mensuration*, where that admirable author treats so fully on the quadrature and cubature of curves in general, found, what he had in truth forgotten, (not having looked to that part of Hutton's Treatise for some years,) that the first proposition in section 2 of the said Part IV. is essentially the same as the general proposition in this communication, and made to depend upon a similar theorem. The said theorem, or lemma, is, however, demonstrated much more simply than in Hutton's work, so that the communication may retain its utility; although, as P. M. W. wishes us explicitly to state, it can now have no pretensions to originality.]

THE SPIRIT OF KNOWLEDGE.

(*Extract from an address by Thomas Steele, Esq. to the Juvenile Liberal Club of Clare.*)

A celebrated treatise has been written upon "The Spirit of Law;" I do not know that any one has yet written a treatise upon "The Spirit of Education," but it would afford a splendid subject expanded into its details. The germ of the subject has been so nobly treated by the Roman historian, Sallust, that I do not recollect any thing which I have ever read to exceed it in justness of sentiment, or to equal it in the concise energy by which the sentiment is struck home to the heart of the reader. It is a succession of "*æternæ veritates*," put forward with the utmost rapidity and clearness; and the subsequent histories form an exquisite commentary upon such an exordium. What says the Roman historian? He says, "It is right and fitting that all men, who aspire to excel the other animals, should not only exert themselves, but that they should strain their energies (*summâ ope niti decet*) to effect this purpose; and that they should not pass through existence as if they were beasts of the field, which nature has formed with heads not erect, and rendered subservient to the impulses of mere animal nature." He speaks of the brief duration of our personal existence, and urges the consequent necessity of making every effort to cause that our memory may live with posterity as long as it is possible. Now, how does this great Roman historian describe virtue, and how does he describe the nature of the pursuits that ought to occupy the attention of an intellectual being? Of virtue, he says that it is refulgent and eternal (*virtus clara æternaque habetur*); and, after saying that he estimates alike the life and death of the debauched and slothful, and the ignorant and uncultivated—the following is his description of a living man:—"But that man appears to me indeed to live, and to be an 'intelligential substance,'

who, with his mind exalted in the pursuit of some important purpose, and disdaining all trifling pursuits and dissipation, (*Negotium, quasi nec otium,*) aspires to fame either by the achievement of some glorious action, *or by the exercise of some art useful to society.*" [*Verùm enimverò is demùm mihi vivere atque frui animâ videtur, qui, aliquo negotio intentus, præclari facinoris aut artis bonæ famam quærit.*]

NOTES OF A COURSE OF LECTURES ON MECHANICS, DELIVERED BY DR. LARDNER AT THE LONDON UNIVERSITY—SESSION 1828–29.

Previous to entering into the science of mechanics, it will be necessary to explain a few of the properties of bodies.

Cohesion is that property by which the several particles of any substance, &c. are kept united, and without which there would be no difference in the natures of bodies. All the various phenomena of a body, being tough, hard, soft, &c. are the effects of a greater or less degree of cohesion. Some bodies have greater intensity of cohesion, in proportion to the magnitude of their spheres of action, than others. For example, if a piece of iron be drawn asunder (which will require an immense force) it will be almost impossible with any weight to unite the pieces, however large may be their spheres of action, shewing that the cohesion is but small; while a piece of India rubber may be stretched out to a great length, and, if broken, can easily be joined by pressure, though the sphere of action be but small; by which it may be easily seen how much stronger the cohesion is in India rubber than in iron.

Cohesion exists not only between materials of the same kind, but also between those of different kinds, as between solids and liquids, &c.

There is another kind of cohesion called *capillary attraction*, which is a propensity that water or any other liquid has to ascend in small tubes, as the pores of sponge, &c. The cause which produces this effect has occasioned great dispute; but the investigation of the merits of each opinion is too much mixed up with mathematics for the present course of lectures. An illustrative and amusing experiment may be tried by immersing one end of a piece of thick cotton in a glass of water, and letting the other end hang down on the outside, when the glass will be emptied in a short time.

Impenetrability is an universal property of matter, and susceptible of no degrees.

Example. — Suppose two cannon-balls were proceeding towards each other with the same force and velocity in opposite directions, if they *were* penetrable they would pass through each other and continue their courses; but this is impossible, and therefore they are impenetrable.

The *pores* of a body are the interstices between the particles which constitute the mass or quantity of matter; and it is by the closeness of these particles that the different degrees of *density* are formed. Thus, the denser a body is the fewer pores it has. If a tube be half filled with water, and then *gently* filled up completely with sulphuric acid, after shaking them together, the mixture will be found to have diminished considerably, which may thus be accounted for:—The particles of the sulphuric acid being less than those of the water, when mixed together the former occupy a great part of the space previously held by the pores of the water, in the same manner as a mixture of shots and bullets will occupy less space than the two separately. Silver and copper, when mixed, will produce the same effects, and many persons have been deceived, in mixing spirits and water, by the same phenomena resulting.

The *volume* of a body means its pores included with its particles.

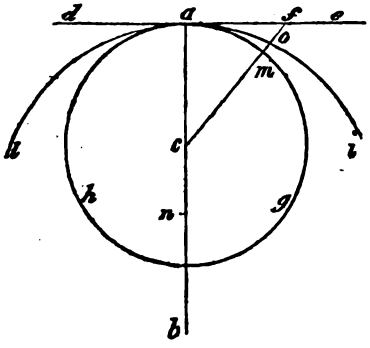
There are many curious examples of the property of *divisibility*, which may not be uninteresting. If a pound of silver be melted together with a grain of gold, every grain of the mixture will contain a visible particle of the gold, which may be detached by means of aqua fortis; consequently, one grain of gold may be divided into 5761 *visible* parts. A grain of musk

may be placed in a room where the air is continually being changed, and at the end of 20 years no sensible diminution of bulk will be discovered, although it may be supposed that particles of it were constantly flying off to scent the air. Lewenhoek has discovered many other properties which may not be uninteresting. The size of the animalculæ in water bears about the same proportion to a mite that a bee would do to a horse. The milt of one cod-fish contains a greater number than there are human beings on the earth.

It is in consequence of this property that it is impossible there can be a perfect vacuum in the receiver of an air-pump; for though there are some machines which will extract $\frac{9}{10}$ths of the air contained in them; yet they will be as perfectly filled by the remaining $\frac{1}{10}$th as they were by the whole.

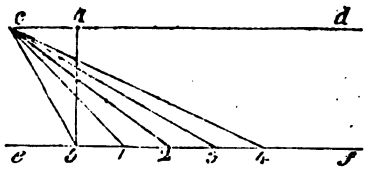
There are two ways of shewing to how great an extent one may imagine this property to reach.

From a point c in a straight line,



ab, describe the circle agh; to this circle draw the tangent de, and from the centre c draw the line cf, which is the line wished to be divided, and which is cut in the point m. Now, from a point n, still lower in the line ab, describe another circle ail touching the tangent in the same point a as the other one did, and the line ef is again cut by this circle in the point o. Therefore, the part fo is evidently less than fm. Now it is evident, that by increasing the radius of the circle, it shortens the part of the line ef cut by the circle; and as no bounds can be given to the length of this radius, so there are no ends to the divisions of the line cf.

The following is the second manner:



To the line ab draw the two perpendiculars cd and ef, and along the line bf mark off even spaces, as at 1, 2, 3, 4, &c., and from the point c draw the lines $c1$, $c2$, $c3$, $c4$, &c. Now it is evident that the line $c2$ cuts the line ab at a point nearer a than the line c, and $c3$ nearer than $c2$, and $c4$ than $c3$, &c.; and as cd and ef are parallel, the lines $c1$, $c2$, $c3$, $c4$, &c. may be continued to infinity, and each *succeeding* line will approach nearer to the point a than the *preceding* one, but will never touch it.

The expression "*infinity of division*" must not be confounded with "*infinity of divisibility*;" the former means that degree of infinity which may be attained by *real* measurement, while the latter implies that to which there are no limits attached.

Previous to concluding this subject, it may be entertaining to describe Dr. Wollaston's ingenious manner of procuring fine wire for astronomical purposes — for ascertaining the distance between any stars, &c.; on the accuracy of which depends all the perfection of the study of astronomy. It had been found that when the very finest thread was placed across the end of a telescope, it was magnified beyond the star's apparent size, and consequently hid it from view; for although the stars appear very large when seen with the naked eye, yet this is the effect of radiation alone; and a star, when viewed through a good telescope, is nothing but a brilliant point. Dr. W.'s manner of obtaining the wire was this:—He procured a slender cylinder of silver, through the axis of which he drilled a hole, the diameter of which was $\frac{1}{10}$th part of that of the silver;

this hole he then filled with platina; the whole wire was then drawn until the entire diameter was no more than the $\frac{1}{500}$th part of an inch; consequently, he had a wire of platina within the silver equal to the $\frac{1}{3000}$th part of an inch in diameter; and this he disengaged by immersing the whole in nitric acid, which precipitated the silver, and left the platina unaffected.

(To be continued.)

THE NAUTICAL ALMANAC.

Sir,—It was some time ago announced that government had been at length awakened to the necessity of rectifying the many blunders for which the Nautical Almanac has been long so disgracefully notorious. Will you give me leave to ask, through your medium, what it has been doing since it was awake? Who is the new Superintendent? Or, if we are to have a new board, who are the members? In your notices, Mr. Editor, on this subject, you overlooked what I thought to be a very piquant argument in favour of a reform. It is given by Mr. South in the form of a story, which goes thus: When Captain Smyth was employed in making a survey of the shores of the Mediterranean, he fell in with a Spanish frigate; an interchange of civilities took place, and Captain S., knowing how much the Nautical Almanac of England was, in former and better times, prized by foreign seamen, gave the Spanish captain all the volumes of it which he possessed. Fortunately, for the benefit of hydrography, Captain Smyth, with his *foreign* ephemerides, found his way to England; *but there is an awkward story afloat, that the Spanish captain has not since been heard of.* As Mr. South pithily adds, *Quid est, si non hæc contumelia?*

I am, Sir, &c. ORION.

ASTRONOMICAL DISCOVERIES.

The late Sir W. Herschell directed the attention of astronomers to the importance of determining the distances and positions of double and triple stars, or stars which appear single to the eye, or when seen through an inferior telescope, but when viewed with *one of higher magnifying* powers, are found to consist of two or more distinct stars. Sir W. Herschell published descriptions and names of 702 such double and triple stars. Messrs. J. W. H. Herschell and Mr. South subsequently instituted a series of observations to determine the existence and amount of annual parallax of these stars; but this object was soon lost sight of amid the more extensive views of the construction of the universe which gradually unfolded themselves. These gentlemen have established the existence of binary systems, in which two stars perform to each other the offices of sun and planet. They have ascertained, with considerable exactness, the periods of rotation of more than one such pair. They have observed the immersions and emersions of stars behind each other, and have detected among them real motions sufficiently rapid to become measurable quantities in very short intervals of time.

CURRENTS OF THE OCEAN.

The following interesting observations on this subject were made by Captain Sabine, in the course of one of his recent scientific voyages:—

"In the voyage between Cape Mount and Cape Three Points, the *Pheasant's* progress appears to have been accelerated 180 miles by the current, which, in the season when the south-west winds prevail on this part of the coast of Western Africa, runs with considerable velocity in the direction of the land round Cape Palmas, to the eastern parts of the Gulf of Guinea. In the passage between the River Gaboon and Ascension, being a distance of 1400 geographical miles, the *Pheasant* was aided by the current above 300 miles in the direction of her course. But the more important distinction, both in amount and in utility in navigation, is between the waters of the equatorial and the Guinea currents. These exhibit the remarkable phenomenon of parallel streams, in contact with each other, flowing with great velocity in opposite directions, and having a difference of temperature amounting to ten or twelve degrees. Their course continues to run parallel to each other, and to the land, for above 1000 miles; and according as a vessel, wishing to proceed along the coast in either direction, is placed in the one or the other current, will her course be aided from

40 to 50 miles a-day, or retarded to the same amount. On the day after the *Pheasant* sailed from Maranham, she entered the current, the full strength of which she had quitted to go to that place, and it was then found to be running with the astonishing rapidity of 99 miles in 24 hours. On the 10th of September, at 10 A.M., while proceeding in the full strength of the current, exceeding four knots an hour, a sudden and very great discoloration of the water a-head was announced from the mast-head; the ship being in 5° 08′ north latitude, and 50° 28′ west longitude, (both by observation,) it was evident that the discoloured water could be no other than the stream of the Amazons, pursuing its original impulse at no less than 300 miles from the mouth of the river, its waters not being yet mingled with those of the ocean, of greater specific gravity, on the surface of which it had pursued its course. It was running about 68 miles in 24 hours. On a general view of the currents which have been thus particularised, on the *Pheasant's* progress, in her voyage commencing at Sierra Leone and terminating at New York, it may be seen that she was indebted to their aid on the balance of the whole account, and in the direction of her course from port to port, not fewer than 1600 geographical miles, the whole distance being under 9000 miles; affording a very striking exemplification of the importance of a correct knowledge of the currents of the ocean to persons engaged in its navigation, and consequently of the value of the information in the acquisition and arrangement of which Major Rennell has passed the later years of his most useful life. The publication of the charts of the currents in the most frequented parts of the ocean, which he has prepared with his accustomed and well-known indefatigable assiduity and strict adherence to the evidence of facts (as soon as he shall deem them sufficiently complete), will be a most important service rendered to practical navigation."

MATHEMATICAL EXERCISES.

1. What curve does the cross of St. Paul's Cathedral (lat. 51½° N.) describe every twenty-four hours?

2. There are two stone pillars whose perpendicular heights are twenty and thirty feet, and the distance between them sixty. A ladder is to be placed at a certain point in the line of distance, of such a length that from thence it may just reach the top of both the pillars. Where is that point, and what is the length of the ladder?

3. The slant height of a wall is equal to twice its horizontal thickness; find its inclination when it will be just supported.—(Proposed by Mr. Thomas Hogan.)

4. Find the centre of gravity of the three squares described on the three sides of a right-angled triangle.—(Also proposed by Mr. Hogan.)

Answers to be sent in to the Editor before the 1st of November, when the best of those then received will be selected and published.

ALGEBRAIC EXERCISE.

(*For Young Beginners.*)

$$\text{Given } m = \frac{dx^2 + \dfrac{b^2x^2dx^2}{a^2\cdot(a^2-x^2)}}{\dfrac{abdx^2}{(a^2-x^2)^{\frac{1}{2}}}} \times \frac{-b.xdx}{\dfrac{a\cdot(a^2-x^2)^{\frac{1}{2}}}{dx}} + x.$$

$$\text{And } p = \frac{dx^2 + \dfrac{b^2}{a^2}\cdot\dfrac{x^2dx^2}{a^2-x^2}}{\dfrac{abdx^2}{(a^2-x^2)^{\frac{1}{2}}}} - \frac{b}{a}\cdot(a^2-x^2)^{\frac{1}{2}}.$$

Shew that (when $e^2 = \dfrac{a^2-b^2}{a^2}$, and also, $n = ae^2$, and $q = \dfrac{a^2e^2}{b}$), there will, by the elimination of x between the two equations, result $\left(\dfrac{m}{n}\right)^{\frac{2}{3}} + \left(\dfrac{p}{q}\right)^{\frac{2}{3}} = 1$.

Note.—The more experienced will recognise the equation to the evolute of the ellipse. The equation to the ellipse itself may be put under the more elegant form of that of its evolute, being $\left\{\dfrac{y}{b}\right\}^2 + \left\{\dfrac{x}{a}\right\}^2 = 1$.

Answers to be sent in before the 1st of November.

BRIGGS'S STEAM-ENGINE—HARDENING THIN STEEL PLATES.

Sir,—I cannot allow the sneers of your correspondent, Mr. H. M. Briggs, (No. 310, p. 356,) to pass unnoticed; and let me tell him, that if his engine will not stand the test of that science which he seems so much to despise, he had better never bring it before the public. Has Mr. B. ever heard of Mr. Perkins? has he ever heard of the American Buchannan? and a host of other wonder-working engineers, who have shared the same fate? And if the intelligent and scientific Mr. Gillman was obliged to acknowledge that he had been deceived by his experiments and models, it will not be surprising (notwithstanding his present confidence in his discovery) if Mr. B. should hereafter occupy a page in the chapter of blunders, instead of a niche in the temple of fame. Is Mr. B. really aware of the amount of what he has promised to perform? If he is, I scarcely know what to think of him; if he is not, I will take the liberty of informing him. *He has promised that, with the same expenditure of steam, he will perform eight times the labour, or, in other words, that he will overcome eight times the resistance.* I am supported in the above assertion by Mr. Tredgold; see "Mechanics' Magazine," vol. iv. page 431. But perhaps Mr. B. has made some discovery analogous to that of Mr. Chapman's (page 74, vol. xi.) for "*boiling cold water or other liquids*;" if so, there can be no question that a great saving will be the result of his discovery.

In reply to "A Plain Mechanic," (No. 276,) I would observe, that if his steel plates are intended for saws, they must be heated in a furnace, taking care that the heat is not too high, for a high heat destroys the quality of the steel. When the plate has acquired the proper degree of heat, it must be taken out, and plunged edgeways into a composition of oil and tallow, to which some add a portion of pitch; the oil, however, forms the principal part. After being hardened, it must be taken and tempered over a charcoal fire to the proper degree of hardness, which varies for particular purposes. *The plates must* then be hammered flat, and then ground. The hammering, however, destroys the spring required in tempering, but may be restored by holding it over a charcoal fire until it appears of a straw colour. It must be observed, however, that the above process is not the work of any single individual. The hardening is an art, the hammering is an art, and the grinding is an art; each of which requires some experience, which cannot be taught by any written directions.

I remain, Sir,
Your very obedient servant,
A. MACKINNON.

Sheffield, August 3, 1829.

NEW METHOD OF OBTAINING THE DISTANCE BETWEEN THE SUN AND MOON, OR BETWEEN THE MOON AND A STAR, IN ORDER TO FIND THE LONGITUDE AT SEA.

Sir,—Having been engaged for a series of years in teaching nautical astronomy, and those sciences connected with it, and having had occasion to examine most of the authors who have more immediately devoted their attention to this useful art, I have found none who has farther illustrated this science than the late Dr. Mackay, author of an admirable Treatise on the Longitude: indeed, Robertson's Navigation, and Mackay's Longitude, are first-rate books on the subject. The great difficulty attending the nautical art is to determine the longitude at sea; and various methods have been employed for this purpose. It has been discovered, however, that finding the true distance between the sun and moon, or between the moon and a star, is the best at sea that can be practised at present. From refraction and parallax, however, this great problem has been attended with considerable difficulty in its mode of calculation. "The method of reducing the apparent to the true distance (says Mackay*), or, in other words, that of clearing the apparent distance from the effects of refraction and parallax, being the most tedious part of the calculus for ascertaining the longitude, when the calculation is performed by the common spherical analogies, many

* Page 149, 3d edition, London.

eminent astronomers and mathematicians have given compendiums to facilitate this problem." In the common epitomes of navigation, very long approximations are only given of this problem, such as the methods of Lyons, Mitchell, &c.; but the great *desideratum* is to obtain a short and strictly accurate method, to induce seamen to practise it, and without being alarmed at its length or difficulty. The following is very short, and strictly accurate, and, as I believe, *new*. I have therefore sent it, hoping that it may be acceptable to the public, through your medium, should you think it worthy of insertion, and am, Sir,

Your very humble Servant,

JAMES SINCLAIR, *Teacher*.

Dunfermline, May 22, 1828.

Example by Natural Versed Sines, and Common Arithmetic.

Let the apparent distance between the sun and moon be 59° 28′ 20″, the apparent altitude of the sun 56° 52′, and that of the moon 38° 24′, and the moon's horizontal parallax 61′ 16″. Required the true distance? *Ans.* 58° 52′ 26.

Comp. app. alt. ⊙	33°	8′		Comp. true alt.	33°	8′ 32″	
Ditto . . . ☽	51	36		Ditto . . .	50	49 10	
Sum . . .	84	44	N.V.S. 906209		83	57 42	N.V.S. 894697
Diff. . . .	18	28	N.V.S. 051492		17	40 38	N.V.S. 047218
			856717				847589

App. distance	59°	28′ 20″	N.V.S.	492044
Diff. app. alt.	18	28 0	N.V.S.	051492
				440552

By Arithmetic.

$$\frac{847589 \times 440552}{856717} + 047218 = 483075 \text{ N.V.S. } 58° 52' 26'' \text{ true distance.}$$

By Logarithms.

Diff. of N.V. sines of sum, and diff. of compts. of sun and moon's app. alts.	856717	Ar. Co.	4·067163
Diff. of N.V. sines of ditto, true alts.	847589	Log.	5·928185
Diff. of N.V. sines of app. distance, and diff. of app. alts.	440552	——	5·643996
	435857	Log.	5·639344
	047218	N.V.S. diff. true alts.	

True dist. . . . . 58° 52′ 26″ N.V.S. 483075

N.B. The correction for the sun in the above case is −0′ 32″, and for the moon +46′ 50″.

[Mr. Sinclair's "Demonstration" of his method we shall give in a subsequent Number.—ED.]

DETERIORATION OF GOLD BY MERCURY.

(*From the Ennis Chronicle.*)

We beg leave to suggest the necessity of preserving gold coin, and all kinds of golden articles, from contact with quicksilver and all mercurial preparations. We have known several instances of gold rings bursting on the fingers of persons using mercury, or handling quicksilver. A few days ago, a gentleman in the country had a gold sovereign, in colour and excellence of execution not to be distinguished from several others in his possession, and of full weight and measure; but, on being slapped against a table, it sounded like lead, and on being pressed with the finger and thumb obliquely against the table, snapped in two, like a bit of rotten stick; he naturally concluded it was counterfeit and base coin, whereas we have no doubt it was a genuine coin that had come in contact with quicksilver. Indeed, this might possibly be

the same sovereign which we saw about three weeks since, in a shop in this town, with the appearance of having been dipped in quicksilver, being partly silvered over, which appearance was removed by the application of aqua-fortis, at our suggestion. We wish some of our philosophic readers would inform us if there is any mode of recovering the precious metal from the deterioration occasioned by the contact with mercury.

INQUIRIES.

Sir,—I will thank any of your correspondents for information on the following questions: Who was the inventor of chain rigging? Was ever a patent granted for it? (I have some reason to suppose there was about the year 1804.) In what name was it granted?—when?—and for how long? Whether such rigging has been used in the Royal Navy, East India Company's service, or any other service? and to what extent?

I am, Sir, yours, &c. Y. Y.
Huddersfield.

Sir,—I am much in want of a recipe for a lacker or varnish that might be applied to tinfoil to make it look of a deep gold colour, after polishing it with some sort of burnishing iron, without destroying the very cold quality which tinfoil so peculiarly possesses.

I remain, Sir, yours, &c.
F. L. M.

Sir,—I have a pair of bellows more than five feet broad, and which allow of the lower part to rise and fall about thirty inches. I am at present employing two men to work them, by standing upon the lever to depress it. I shall feel obliged by any of your scientific readers pointing out to me some better method of working them; and I beg leave to ask if a pendulum could be successfully applied, as there is plenty of room in the building?

I am, Sir, &c.
A MEMBER OF THE SHROPSHIRE MECHANICS' INSTITUTION.

Sir,—I shall feel particularly obliged to any of your numerous correspondents to inform me, through the medium of your useful journal, of the best and most complete method of lackering and re-lackering brass ornaments, with the manner of cleaning and preparing them before the lacker is applied. I mean such ornaments as old lock furniture, draw-handles, lamp-brass, &c.

I am, Sir, &c.
AN OLD SUBSCRIBER.

P.S. I have every Number of the "Mechanics' Magazine," but cannot find any good or satisfactory method.

NOTICES TO CORRESPONDENTS.

The "Method of Extracting the Fifth Root," with which Mr. W. C. has favoured us, is, as he himself states, not to be "always found in books of arithmetic;" but the reason of its being generally excluded from them is one which operates with equal force against its admission into the pages of the "Mechanics' Magazine"—it is of no practical use.

The "New Methods of performing Practice by means of Reduction," &c. by the same correspondent, are all very well known. We beg, however, he will accept our thanks for his good intentions.

Maxima and Minima.—We hope Mr. Hall will agree with us that this subject is already in very competent hands, and had better be left there. Mr. H.'s paper appears to have been written before the appearance of that by G. S.

We have a letter from Mr. Foord, in which he "returns his grateful acknowledgments to O. C. F. and G. S. for their several remarks and criticisms on his method of lines for finding angles," but maintains that his errors were not so considerable as G. S. has represented, being only about seven degrees instead of thirty, &c. G. S. has himself frankly admitted this in our last Number. Besides, Mr. Foord need not be informed that a degree in land measuring is like an inch to a nose—a great deal.

We shall publish, in the course of a week or two, a communication from our esteemed correspondent P. M. W., which will be worth apples of gold to practical men. It is a table, on a single page, of natural sines, cosines, tangents, corangents, secants, and cosecants, to every degree of the quadrant, with explanatory observations: by means of which civil and military engineers, surveyors, architects, &c., may, without having recourse to logarithms, be enabled, by simple operations in decimal arithmetic, to solve all problems in trigonometry with the greatest accuracy. The celebrated Lalande is said to have been more proud of his portable logarithm tables, which sold for four francs, than of all besides that he ever published; but, justly prized as these have been, we hesitate not to affirm, that this little table of P. M. W.'s, which will not cost the tenth of that sum, will be found of tenfold greater practical utility.

Is "Mathesis" the same person of whom the poet writes—

"Mad Mathesis alone was unconfin'd,
Too mad for mere material chains to bind?"

His "Theory of Nature" is left for him at our office.

The notice to "Watch Finishers" is an advertisement, but may have a place on the cover of the Monthly Part, on payment of the usual charge.

Mr. Taylbail's communication has been recovered, and shall have an early place.

Communications received from Mr. Woolgar—Mr. Saul—Mr. Eriddely—S. P. W.—O. C. F.—G. S.—Mr. Murdoch—Mr. Hopwood—Z.—J. O. B.—J. W.—Mr. Webb—F. G. S.—Hindostanee—Mr. Taylor.

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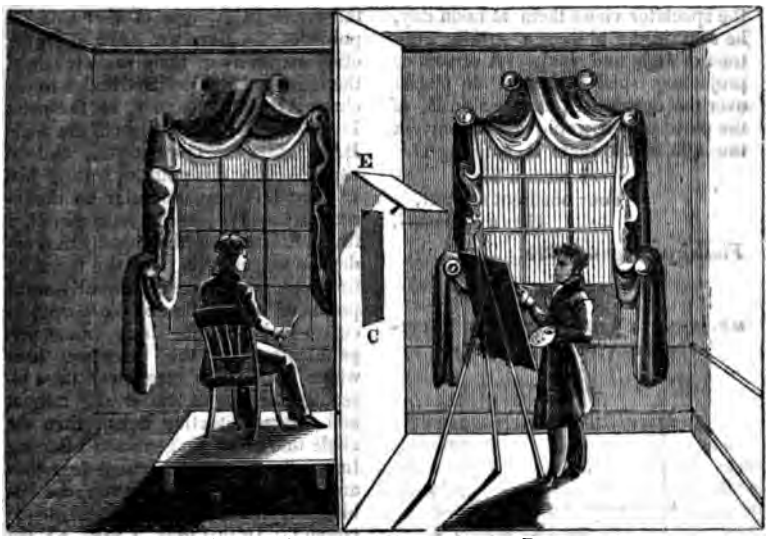
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 317.] SATURDAY, SEPTEMBER 5, 1829. [Price 3d.

"Whether thy hand strike out some free design,
Where life awakes and dawns at every line,
Or blend in beauteous tints the coloured mass,
And from the canvas call the mimic face,
Read these instructive leaves."—POPE.

PLAN OF AN ARTIST'S STUDY.



ARTIST'S STUDY.

Sir,—In the practice of portrait painting, it is essential to have a good light thrown on the face, for, such shadows as are produced on the countenance by the light admitted into the artist's room, the same he must necessarily transfer to his canvas. We see therefore a material difference between the portraits by Rembrandt and those by Rubens; the former painted by the light of the small window of a mill, while the latter had light from nearly the whole side of the apartment. The plan most in vogue at the present day is to darken all the window, except the top row of panes, *but this, at certain seasons, is attended with* the disadvantage of darkening the room so much, as often to deprive the painter of a sufficiently clear light on his canvas. I think it would not be impossible to arrange an artist's study, so that the person, sitting for a likeness, should be in strong light and shade, and yet the artist have a broad light for the advantage of seeing his work

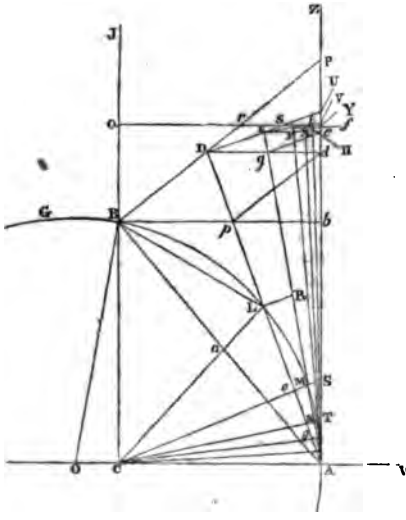
The above engraving is intended to illustrate my plan. It represents an artist's study, having two windows, between these there is a partition A, of wood, or a thick curtain, dividing the room into separate apartments. In the partition, near the window, and about 4 feet from the floor, there is to be an opening C, of 3 or 4 feet square,

through which the artist, standing in the room B, may see the person in D. The room D, has the window partially closed, the top part alone being open. The division B, occupied by the artist, may have as much of the window blinded up as occasion requires; but however light, or however much darkened, the appearance of the shade on the features of the person sitting in B, will remain unaltered. Something of this kind is to be observed when we look at persons standing at a window, door, or other opening, under a covered way, or at the window of a house, when the front is in shade, for though the spectator views them at noon day, he sees in the objects a striking contrast of light and shade. A screen or projecting shed E, might be placed over the opening C, on the side B, of the partition, it would act to prevent the light of the room B, entering D.

I remain Sir,
Your obedient servant,
HENRY D——.

Finsbury, August, 1829.

MR. SANKEY'S GEOMETRICAL RECTIFICATION OF THE CIRCLE.



Sir,—In my short communication *inserted in your 309th Number, I referred to the elegant geometrical* rectification of the circle, published by Mr. Sankey. As his method is as simple in practice as it is beautiful and satisfactory in theory, and leads to some curious deductions which are within the reach of students only moderately versed in geometry and trigonometry, I now transcribe it for the use of that class of your readers to whom such researches are always instructive.

"*To find a line which shall ultimately be equal to any given arc of a circle.*

"Let AB be the given arc of a circle AGB; draw the chord AB, also the indefinite right line AZ, touching the circle in A, one of the extreme points of the given arc AB; at B, the other extremity of the given arc, draw the right line BD perpendicular to the chord AB, and meeting, in the point D, a line AD, which bisects the angle BAZ under the tangent AZ, and the chord AB; at this point of intersection D draw DE perpendicular to the bisecting line DA, and meeting in E, a line AE bisecting the angle DAZ under the tangent AZ, and the bisecting line AD; and so on continually at the points of intersection of the perpendiculars and bisecting lines, raise perpendiculars to the bisecting lines which shall again meet new lines bisecting the angles under the tangent and former bisecting lines; then the angle under the tangent and bisecting line will ultimately become less than any given, and consequently the last bisecting line will coincide with the tangent. In this case, I say, AY the ultimate intercept of the tangent between A, the point of contact, and Y its intersection with XY, the last perpendicular raised to the bisecting lines, will be equal to the given arc AB.

For, at L, M, N, &c., the points of intersection of the bisecting lines with the given arc, draw the lines LR, MS, NT, &c., perpendicular to the bisecting lines AD, AE, AF, &c., and meeting the bisecting lines AE, AF, AH, &c., in the points R, S, T, &c.; draw also the lines LB, ML, NM, &c. Now, on account of the equal angles LBA and LAB, and the right angle DBA, it is evident, that the line DA is bisected in L, its point of intersection with the arc AB; therefore the entire bisecting line DA : LA, the part which

is intercepted by the circle AGB :: the given arc AB : its intercepted segment LA. And in like manner, and on account of the parallels LR, DE, MS, EF, NT, FH, &c., it can be shown in general, that any bisecting line : that part of it which is intercepted by the circle : : the given arc : its corresponding intercepted segment; but the intercept of the bisecting line will ultimately coincide with and become equal to the intercepted segment of the arc; therefore, the bisecting line itself will ultimately become equal to the given arc : this, of course, will take place, when the angle under the bisecting line and tangent vanishes, consequently AY, the ultimate intercept of the tangent, between XY the vanishing perpendicular, and the point of contact A, will be equal to the given arc AB.

Your readers will perceive, that in the practice of this method, nothing is required in approximating to the length of any arc of any circle, but a succession of the simple operations of bisecting angles and raising perpendiculars; and that even a few such operations will, in any specific case, give a valuable approximation. It will also be seen, that the ultimate result contemplated in the theory would actually rectify the poposed arc, that is to say, would produce and present a right line that should be equal to it. This in theory is a beauty that Archimedes and Newton would have admired.

Mr. Sankey subjoins to this construction some series, and dependent computations for the length of any arc, as well as some connected inquiries on the subject of the quadratrix, with which mathematicians will be gratified. But it does not seem to have occurred to him that his method involves a geometrical demonstration of a long and greatly admired series of Euler, in which he exhibits an arc in a continued product of its sine and secants of submultiple arcs. As the research is not difficult, and will lead to a practical method of computing the length of an arc, perhaps you will allow its insertion in the "Mechanics' Magazine."

Recurring to the preceding diagram, it is evident, that CB is the sine of the proposed arc AB, to the radius OA or OB. Also, since the angle included between a tangent and a chord, is measured by half the arc of that chord (Geom. Hutton's Course, th. 48.) therefore the angle bAB=ABC (by the parallels Ab, CB,) =$\frac{1}{2}$angle AOB; and therefore AB is the secant of $\frac{1}{2}$ AOB to the radius BC. So again, AD, which is the secant of $\frac{1}{2}$ bAB to the radius AB is the secant of $\frac{1}{4}$ AOB, to the same radius. And, in like manner AE=secant $\frac{1}{8}$ AOB to radius AD; AF=secant $\frac{1}{16}$ AOB to radius AE; and so on. Consequently, if a be any arc or angle, we have arc a=sin. a. sec. $\frac{1}{2}a$. sec. $\frac{1}{4}a$ sec. $\frac{1}{8}a$. sec. $\frac{1}{16}a$., &c. which is Euler's series of dependent factors.

Now, to evince the utility of this in practice, suppose we compute, by means of the trigonometric tables of logarithmic sines and secants, which will effect the successive multiplications by so many additions, the arc of 80 degrees to the radius 1. In doing this, I will, after the first four terms, set the numeral value of each new product, that the steps of the approximation may be readily traced.

Log. sin 80°=9 9933515	
sec 40°=0·1157460	
sec 20°=0·0270142	
sec 10°=0·0066485	
(Rejecting the 10°.) 0·1427602	sum=Log. of 1·3891654 approx. arc of 80°
sec 5°=0·0016558	
0·1444160	sum=Log. of 1·3944916 2d approx.
sec 2° 30′=0·0004135	
0·1448295	sum=Log. of 1·39581 3d approx.
sec 1° 15′=0·0001034	

0·1449329	sum=Log. of 1·3961526 }
sec 0° 37½′=0·0000258	4th approx. }
0·1449587	sum=Log. of 1·3962359 }
sec 0° 18¾′=0·0000064	5th approx. }
0·1449651	sum=Log. of 1·396256 }
sec 0° 9⅜′=0·0000016	6th approx. }
0·1449667	sum=Log. of 1·3962614 }
sec 0° 4 11/16′=0·0000004	7th approx. }
0·1449671	sum=Log. of 1·3962627 }
sec 0° 2 11/32′=0·0000001,34	8th approx. }
0·1449672,34	sum=Log. of 1·39626313 }
sec 0° 1 11/64′=0·0000000,34	9th approx. }
0·1449672,68	sum=Log. of 1·39626324 }
	10th approx. }

These two last values of the arc of 30° are true in the sixth place of decimals. And if we multiply the last of them by 9, and divide the product by 4, the result, 3·14159254, differs not before the seventh place of decimals, from the true value of 3·1415926535, &c. of the circumference of a circle whose diameter is 1.

I know of no other series by which so accurate an approximation to a circular arc and circumference can be made with so little labour. And I cannot but hope that, taken together, the geometrical process announced by Mr. Sankey, and my computation, referred to the same principles, will go far toward satisfying your correspondent, M. W. (No. 804.)

O. C. F.

August 20, 1829.

GEOGRAPHICAL CARPETS.

Sir,—The endless improvements which are daily taking place in every branch of knowledge, and the rapid diffusion of them in every quarter of the kingdom, have been not a little promoted by the establishment of your truly valuable Magazine. Many useful hints and much information will be thus preserved for the consideration and advantage of posterity, which might otherwise have been buried in oblivion; and the easy way in which such hints may be communicated through the medium of *your Magazine, greatly* enhances its *value, and has doubtlessly* encreased their number. If you consider the following worthy a place in its pages, you may by inserting them, enable those whom it more immediately concerns, to judge of their utility and importance.

The use of carpets is now become so universal, that every family which can afford one, makes it an indispensable article of comfort; and nothing can excel many of those of our own manufacture, in beauty of design or execution. But I do not recollect having seen any calculated to communicate any kind of useful knowledge, although they are susceptible of it, to a very considerable extent. I think a *carpet* is so admirably adapted to *Geographical instruction*, that it may be almost said to be a natural article for the purpose. A map is a picture of the surface of the earth, and on the ground is the place to view it. One on so large a scale as a carpet would admit, is calculated to give a more correct idea of the relative position of places than could be effected by the largest map now extant. A family in the daily occupation of a room furnished with such a carpet, would acquire unavoidably a more permanent knowledge of a given portion of the earth than could be obtained by any other means; and when the local position of the room would admit, it might be placed agreeably to the bearings of the compass, and it would thereby give a correct idea of the real direction of the places on the map.

A moderately sized carpet would admit very distinctly of a fair representation of all the counties of England, or all the kingdoms of Europe. Perhaps a minute delineation of places could not be admitted, but an outline of the different counties and their names, in the case of England would be sufficient to give a general and correct idea of the kingdom; and of the relative or contigious position of each county. General marks, as the spire of a Church, to denote the situation of the country town; darts to denote the direction of a river, and many other general features of a map, might be introduced without adding much to the complication of the design; and each county or kingdom might be rendered more distinct by giving it a different colour as in other maps now in common use. A portion of the coasts of France or Ireland would likewise be of great advantage.

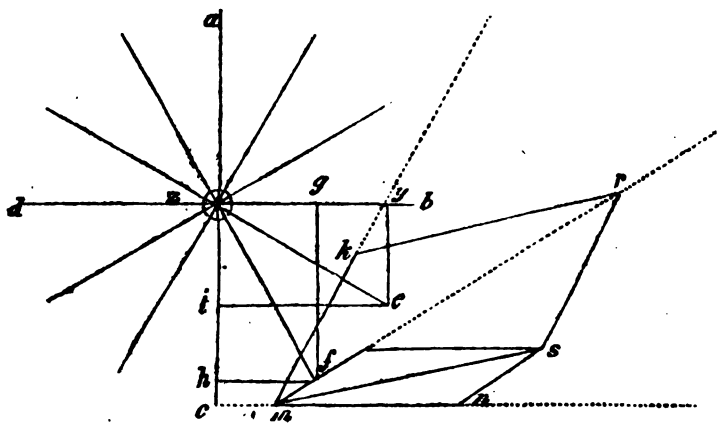
Such a representation of any part of the world being continually in view, would give children a more correct and permanent knowledge of the geography of such places, than any references to maps or globes in common use; and would be more frequently glanced at, as there would be little or no trouble attending it.

Should these hints catch the notice of Carpet manufacturers and be thought worthy of their consideration, their own ingenuity will suggest improvements. I think the demand for such an article would become extensive, and the mutual benefit of trade and society would be the result.

I am, Sir,
Respectfully yours, &c.
A. TAYDHILL.

Birmingham, April 13, 1829.

ON PADDLE-WHEELS.



Sir,—I beg to offer a few remarks respecting the paddle-wheel question, vol. xi. p. 313. Let *a b c d* represent the paddle-wheel, and *d b c d*, the arc of 180°. Hence *d b*, will be the water line. Let us also suppose the quadrant *c z b*, to contain 4 paddles, *b*, *e*, *f*, *c*, *c* being the maximum paddle, and *b* the minimum. It is evident that the increase of propelling power of each paddle, from the minimum point *b*, to the maximum point *c*, will be in ratio to the increment of the cosine *g f*, or to the decrement of the sine *f h*. Hence the propelling power will never cease, before the cosine *g f*, is absorbed in the radius at *d*. And the maximum force will take place when the sine *f h* vanishes at the point *c*; *c n* will be the tendency of the propelling power of the paddle *z c*; and *m r* that of the paddle *s f* and *m y*, that of the

paddle *z e*. Consequently, the last two paddles tend to propel the vessel in an oblique direction to its course, each force cutting its respective paddle at right angles. In order to find the composition or revolution of the forces, (paddles) in their respective positions, (as in the fig.) take any point *m*, when the tendency of the three forces, *y m*, *r m*, and *n m* meet; draw *m n*=*z c*, and *m p*= the sine *f h*, complete the parallelogram *m p s n*, and *m s* will be the direction and measure of the combined forces of the paddles *z f*, and *z c*. Secondly, draw *m k*=*e t*, the sine of the angle at *e*, and complete the parallelogram *m k r s*, and *m r* will be the direction and measure of the combined forces of the three paddles, *z e*, *z f*, and *z c*. and so on for any number of paddles.

I am, Sir, yours, &c.

WM. TONKIN, Mine Agent,
Fowey, Cornwall.

July 11, 1829.

PYTHAGOREAN THEORY OF THE NUMBER NINE.

Sir,—In the communication which I sent to your valuable Magazine, dated the 8th of this month, I observed, that in circulating decimals, the sum of the digits of the circulator will be found to be 9. And it appears to me, that the cause of this singular property may be satisfactorily obtained from what the Pythagoreans have said respecting this number. For the celebrated Pythagorean Nicomachus, in the extracts from one of his lost writings preserved by Photius and entitled Θεολογουμενα αριθμητικης*, informs us that the above mentioned philosophers, celebrated the ennead—as flowing round the other numbers within the decad like the ocean, and that it was also called by them the horizon. An anonymous Greek author who wrote a treatise which bears the same title with that of Nicomachus, and was reprinted at Leipsic in 1817, explains these appellations as follows:

"That there can be no number beyond the ennead, but that *it circulates all numbers within itself*, is evident from the regression of numbers. For the natural progression of them is as far as to 9, but after it their retrogression takes place. For 10 becomes as it were again the monad. Thus, if from each of the numbers 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, the number 9 is subtracted, the numbers that remain will be 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. And *vice versâ*, the progression will receive an increase by the addition of 9. For if to each of the numbers, 1, 2, 3, 4, 5, &c. 9 is added, the numbers produced will be 10, 11, 12, 13, 14, &c. Likewise, by subtracting from 20, twice 9, from 30, thrice 9, from 40, four times 9, from 50, five times 9, &c. the numbers 2, 3, 4, 5, 6, &c. will be produced. By taking likewise from 100 eleven times 9, we again return to the monad. And after the same manner, we may proceed to infinity. Hence it is not possible there should be any elementary number beyond the ennead. Hence, too, the Pythagoreans, called it ocean, and the *horizon*, because all numbers are comprehended by, and revolve within it. On this account, likewise, it was called by them *Halios*,* *concord*, and *Persea*,† because it congregates all numbers, and collects them into one, and does not permit the conspiration of the numbers beyond it to be dissipated.‡

Though your correspondent, G. S. has very ably shewn, that the sum of the digits of the circulator in every circulating decimal is not always 9; yet he seems not to have been aware, that when this is the case, the sum of the digits of the denominator of the fraction from the expansion of which the circulating decimal is produced, will be 9. And, if this be true, by

* *i. e. A Developement of* the Theory *of Arithmetic.*

* i. e. παρα το αλιζειν from *congregating* and *collecting*.

† An epithet of Diana or the Moon, who, as Diodorus Siculus informs us, was much worshipped by the *Persians*, and was called in his time *Persea*. But the Moon in the Orphic hymn to her, is called τελεσφορος, i. e. *bringing to a perfect end*, which accords with the nature of the ennead. See the second edition of my translation of the Orphic hymns, p. 27.

‡ See more on this subject in my Theoretic Arithmetic, p. 206, &c.

making the circulater to be a divisor instead of a quotient, a circulating decimal will be produced, and the sum of the digits of the circulator will be 9. Thus, in the instances which he has adduced, $\frac{1}{17}$ when expanded into a decimal will, as he says, be ·015873,015873, &c.; and the sum of the digits of the denominator 63 is 9. Likewise $\frac{1}{15873}$ when expanded, gives the circulating decimal, ·000063,000063,000063, &c. The same thing will likewise be found to take place, in $\frac{1}{9}$, $\frac{1}{99}$, $\frac{1}{999}$, $\frac{1}{9999}$, &c. when expanded into a decimal series. Thus too $\frac{1}{54}$ when expanded, will be 185,0185,0185, &c. and the sum of the digits, of the denominator 54, is 9. Also $\frac{1}{135}$ will produce when expanded, the circulating series, ·0074,0074,0074, &c.; and, the sum of the digits of the denominator 135 is 9.

Again $\frac{1}{151}$ when expanded, will give the circulating decimal series, ·0065359477124183,0065359, &c. and the sum of the digits of the denominator is 9.

If this should be found to be universally true, there will be as many circulating decimals, having 9 for the sum of the digits of their circulators, as there will be of those that have not. Your correspondent, G. S. will much oblige me, by any additional information on this subject; for I write not for *victory*, but for *truth*.

Your's, respectfully,

THOMAS TAYLOR.

Manor Place, Walworth.

CIRCULAR LOGARITHMIC SCALE.

Dr. Roget's Logometric Scale.

Sir,—Your correspondent Mr. Peacock, (vol. 10, p. 246), speaks of the circular form of the logarithmic scale, as a new idea. In this he is mistaken, it having been described more than a century ago, in "Bion's Construction and Use of Mathematical Instruments, by Stone." A particular account of this form, with a description of some instruments actually made, will be found in the first volume of "Nicholson's Journal of Science," quarto series, 1797.

Until lately, however, the circular form can hardly be said to have been reduced to actual practice. For this step, we are, I believe, indebted to Mr. Joseph Lamb, late of the Royal Artillery, under whose directions they are now made. The following is the title of his pamphlet, "Description of a Concentric Circular Proportioner, an Instrument for abridging and facilitating calculations: particularly adapted to the use of officers of the Army, Civil Engineers, and all persons engaged in Chymical and Mechanical Inquiry, London, 1827," 8vo. 20 pages.

The instrument which I possess, is of brass, consisting of a circle moveable within a narrow ring, and graduated on both surfaces. The effective diameter is 2·5 inches, equivalent to a single straight line of 7·85 inches, or to a double one of 1·57. On one side, both scales are single; on the other, one is single and the other double. The instrument is therefore adapted to the same computations as the lines A, B, C, and D, of Bevan's or Routledge's rules, except those which require the slide to be reversed.

At the end of the pamphlet above mentioned, it is stated that the instrument may be had in silver, brass, or ivory, and with a wheelwork adjustment, if required. It may also be had with all the divisions on one surface.

The graduation of my instrument is very accurate and the subdivisions (except in one instance) are regulated upon the principles laid down in Mec. Mag. vol. 10, p. 173.

The power of reversing the lines is a very important one in sliding rules. In the volume of Nicholson's Journal, before referred to, is a paper, illustrative of the advantages attendant on that method; which are also dwelt upon in a communication by Mr. Silvanus Bevan, in vol. 49, of the Philosophical Magazine and Journal. Both these papers are recommended to the perusal of persons who wish to be well-grounded in the theory and practice of the sliding rule.

In the Philosophical Transactions for 1815, part 1, is a "Description of a new instrument for performing mechanically the involution and evolution of numbers," by Dr. Roget.

The instrument is similar in form to the common sliding rule, and is adapted to perform involution and evolution, both with integral and fractional indices, with the same facility as multiplication and division by the common one. The substance of the paper, together with the engraving, is copied into Rees' Cyclopædia, Art. Sliding Rules.

As in the case of the circular instrument, this ingenious contrivance of Dr. Roget has hitherto been lost to the practitioner. Recently, however, a twelve-inch pattern has been laid down at the expence of Messrs. W. and T. Gilbert, opticians, Leadenhall-street, of whom copies may be obtained.

Last year there was published "The Slide Ruler's Guide, being a practical Treatise on the use of the Artificer's Common Slide Rule," by George Oakley Lucas, 12mo. pp. 40. This little work affords an instance of what is but too common, viz. a person's undertaking to assist the public, before he has made himself acquainted with the extent to which others have preceded him in the same department.

I am, &c.

J. W. Woollgar.

Lewes, Aug. 24, 1829.

ENGLISH ACCOUNTABILITY — EAST INDIA COMPANY'S CHARTER.

Sir,—An accountant cannot be a partizan, therefore the decimal account has been submitted with great propriety to the readers of the "Mechanics' Magazine," (No. 316.)

It is asserted, and most truly, that *Tea* is cheaper in the United States, and in France, than in England.

France exchanges 300 francs of her industry, for 120 rupees sicca, of East Indian. Were France to employ the English accountability, the French par of exchange could be no more than 250 francs.

The English exchange is 24 pence farthing; with the decimal reckoning, it should be, 2*s*. 5*d*. I believe *forty rupees sicca weigh exactly one pound avoirdupois*. As it is agreed, to investigate the East India Company's Charter in the ensuing session, I do not know of a more profitable subject to interest the public attention during this vacation, than the reciprocity of accountability, which you have proposed; and which *must* precede any attempt at reciprocity of trade with the United States, France, and Russia, even with our own colonies.

I am, Sir,

Your very obliged servant,

Hindostanee.

Matida Hill, Aug. 25*th*.

IMPROVEMENT ON THE HYDROSTATIC PRESS.

Sir,—I have often heard it mentioned that the Hydrostatic Press has not been found to answer by bookbinders so well as simple beating. Though no bookbinder myself, the reason which suggested itself to my mind is this, (the fault complained of being that it does not expel the air) that in beating, the instrument used does not fall with such uniform pressure on the edges and outside of a book, as the press does, and so leaves more room for the air to escape. I propose, therefore, that the press be made in a very trifling degree convex, whereby the air would be gradually pressed from the centre to the openings between the leaves and escape. This to me appears so obvious a remedy, that I am induced to offer it to the notice of bookbinders through the medium of your work.

I am, Sir,

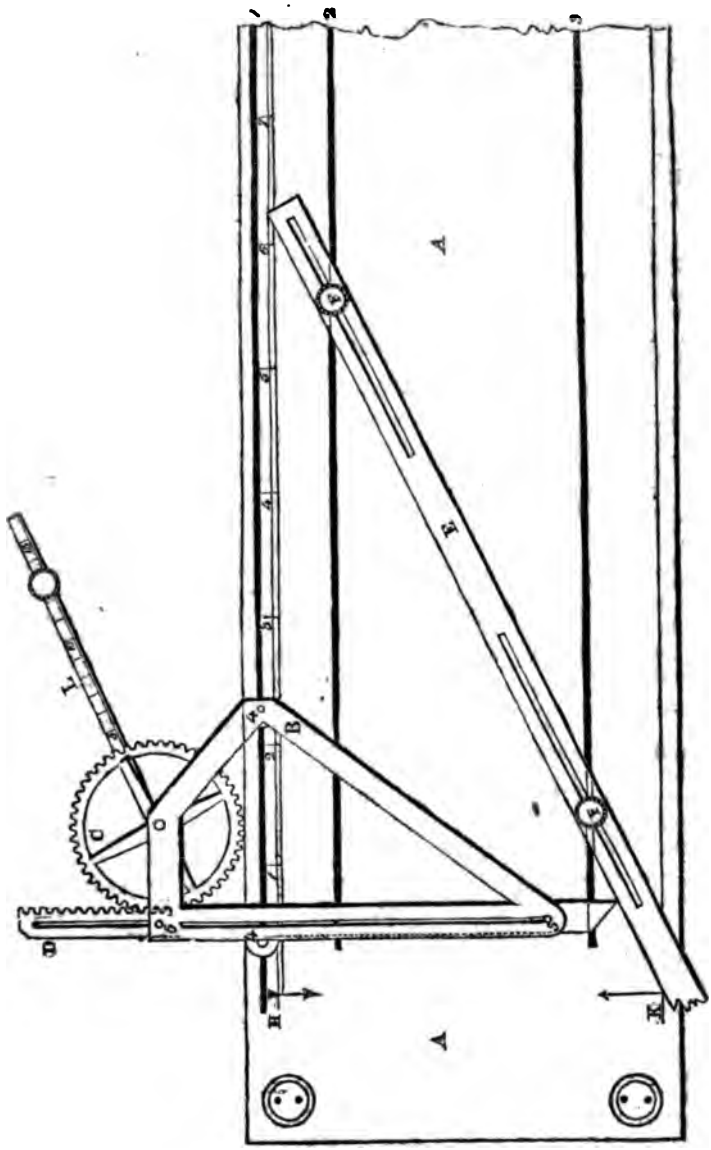
Yours respectfully,

Alfred Holden.

Liverpool, July 6, 1829.

QUICK COINING.

There are eight presses at the Mint, which, on cases of emergency, can all be put in action, and each press coins 40 sovereigns in a minute, making 320 sovereigns by the whole eight presses in a minute, or equal to 19,200 in an hour. Allowance must, however, be made for the breaking of dies, &c. As many as 150,000 sovereigns per day have been coined.



INSTRUMENT FOR DRAWING CYCLOIDS.

To the Editor of the Mechanics' Magazine.

Sir,—I enclose you a plan for drawing cyloids, which I shall be happy to see in your pages.

The description is as follows:—

A, is the plan of part of the frame, being merely a broad ruler, supported on 4 legs, and having brass grooves, 1, 2, 3.

B. A double frame sliding along the groove 1, by pins 4 4.

C. A toothed wheel revolving within the brass frame B.

D. A rack working into the teeth of C, and of sufficient length to turn C once round; it has a pin 5, working in a slit in B, and has a slit in which a pin 6 on B works, and thus its parallel motion is preserved.

F. A ruler, which may be retained in any position by the tightening screws F F, its upper corner being brought to coincide with the line H, of the scale of divisions, and its side with the point K. The distance from H to K, must be exactly equal to the length of the rack, or to the circumference of the wheel C.

L. A bar fixed on to a square part of the axis of C, below the frame, and carrying a sliding tracer, and being divided into any number of equal parts. The scale H, must be divided into a similar number of parts, but the length of a division on H, must be to that of a division on K, as 628 to 1, or as the circumference of a circle to a radius.

To use the instrument, set the tracer on L, to the diameter of the generating circle, and the bar E, to a division on H, corresponding with the division on L, at which the tracer stands, then bring the angular point of the rack to the point K, when the tracer will be immediately below the axis of C, and slide the point of the rack along the edge of the bar E, and the tracer will describe a cycloid by the time that the point of the rack arrives at the line H.

I am, Sir,
Your obedient servant,
J. MURDOCH,
Mech. Draftsman.

4, *Vittoria-place, Mile-End-road,*
August 19, 1829.

NOTES OF A COURSE OF LECTURES ON MECHANICS, DELIVERED BY DR. LARDNER, AT THE LONDON UNIVERSITY.

(Continued from last No. p. 12.)

It is supposed that all matter is composed of elementary monicules, which are quite hard and infinitely minute, and of which there are three things to be observed.

1. No particles are in actual contact *with each other.*

2. They are so minute as not to be distinguishable.

3. They are indestructible by human or natural agency.

To prove the first it need only be shown that a body is compressible, for it cannot be said that the particles themselves are compressed. Thus, when a piece of metal is contracted by cold, the weight remains the same although the size is different. It is the pores, or spaces between the particles that are contracted.

The second observation can easily be imagined, by reference to the description of divisibility before given.

The third property is indestructibility.—It has been very justly and truly observed, that "It is as impossible to annihilate one of the parcles, of which a body is composed, as to form one, and there is not one single particle less in the world now than there were at its creation." The whole power of man consists in making three changes in matter, viz. by combustion, separation, or evaporation. Thus fuel is changed by combustion, some of the particles escape up the chimney in the form of smoke, (and are dispersed over the earth to conduce to the use or pleasure of man) others remain in the chimney in that of soot, while the rest fall in ashes below, or are dispersed about the room as dust.

All substances or materials are divided into three kinds according to the different strengths of cohesion.

1. When the cohesion of a body is so much stronger than its repulsion as to keep it in a firm position, it is called a solid.

2. When the cohesion is equal to the repulsion, or the difference between them on either side is very small, it is a liquid.

3. But if the cohesion be much less than the repulsion, the particles will actually repel each other, in which case they are called gases.

Every thing in nature may be classed under one of these three heads, with only four exceptions, viz. heat, light, electricity, and magnetism; the study of which is too abstract to be treated of in the present course of lectures.

A solid is the only class required to be understood in mechanics; the

other two classes of substances form distinct sciences.

The word solid has three distinct meanings.

In Geometry, it stands opposed to superficies, and signifies that which has three dimensions, viz. height, length, and breadth.

In Mechanics, it has the definition before used, and in which sense only it will be now used.

In Metaphysics, it means any thing which occupies a space, or which must be removed before any other substance can occupy the same space. In this sense air is a solid, as may be proved by plunging an inverted glass into a vessel containing water, which cannot enter the glass until the air is displaced.

With regard to a solid, the first property to be considered is inertia, which may be described as a total absence of activity, an incapacity of any spontaneous action. It is a principle that must be evident to all. It is not a body itself that is inert, but every particle of it is so. There are four kinds to be proved,

1. If a body be at rest it cannot put itself into motion.

2. If a body be in motion it cannot alter its direction or increase its motion.

3. If a body be in motion it cannot stop.

4. Nor diminish that motion.

In illustration of the first definition, it may be observed, that a mass of matter in a state of rest will remain so for ever unless acted upon by some force. It is impossible to imagine that a stone or other substance could move by itself. Now, it can be proved that every other definition can be resolved to this first one.

Second Definition. If in motion, a body cannot increase that motion. Let a body moving with a given velocity suddenly increase at any given rate, say two miles an hour, the same extra force must have been used then which would have moved a body (at rest) two miles an hour, but as no force was used, it would have moved contrary to the first definition. Neither can it alter its direction. In this case the only difference consists in the extra *force being exerted in a lateral direction.*

Third Definition. If in motion, a body cannot stop, then it would require the same force in an opposite direction.

Fourth Definition. If in motion, a body cannot diminish that motion, for the force which when applied against a body in motion, would diminish that motion, would, if it acted upon a body at rest, move it with a velocity equal to the diminution, and which would be contrary to the first definition.

There are three distinct data to be considered, viz. the application, the direction, and the quantity or velocity of a force, all of which are essential.

The property of the third definition of inertia, viz. an inability to stop when in motion, may be shewn in many familiar effects. Stages when they are running with a certain velocity, give the same to the passengers, and when the coach stops suddenly, the passengers would be thrown off were they not prepared. It is in consequence of this property, that a person can leap further by taking a run before doing so; the impetus is gained by the run.

All bodies, as far as have been tried, have inertia, consequently, we may suppose it an universal property of matter. Now, this supposition is made by virtue of what is called mechanical induction, in contradistinction to physical induction, for which, before any conclusions can be drawn, every particle of matter must be tried on. Thus, before it can be said that sand is inert, experiments must be tried on every single particle of the sand; but it is otherwise in mechanical induction, for there if inertia or any other property be discovered in all bodies on which experiments have been made, it is assumed as universal.

It must be remembered that there are two kinds of rests, distinguished by the names of absolute rest and equilibrium; the former produced by its inertia, and the latter by the neutralisation of forces exerted in different directions against the body.

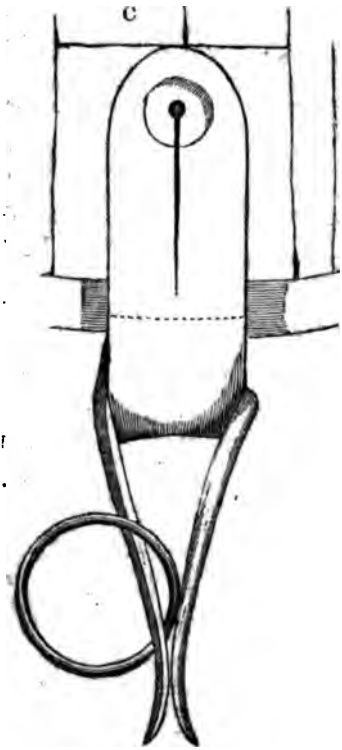
Force is whatever produces or tends to produce motion in a body.

There are two classes of problems derived from the effects produced by the influence of several forces. When under the influence of several forces, a body will be either at rest or it will

move. If at rest, the forces must neutralise each other's effects, and the body will be in equilibrium. The study of this branch of forces is called statics, and its object is to investigate what forces will keep a body in equilibrium. But if these forces do not neutralise each other's effects, it forms another problem in mechanics called dynamics, when a certain number of forces are given in different directions, to determine what will be the position of the body on which these forces act.

(To be continued.)

RIDING-COAT FASTENER.



Sir,—Herewith I send you a sketch of a plan I have used for keeping a great-coat fastened over the knees whilst riding on horseback, which, as I have found useful, I wish you to communicate to your readers for their benefit. I am, Sir,

Your obedient servant,

Lexington, July 12, 1829. W. B.

Description.

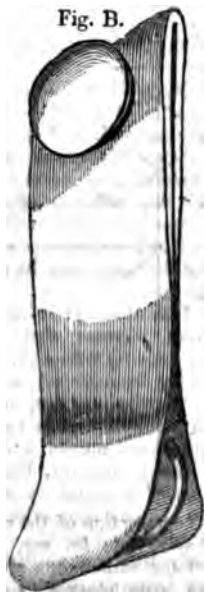
The figure A represents the spring I have used, of the full size.

Fig. A.

This spring (which should be either tinned, silvered, or gilt,) is attached to a leather strap about two inches long, and fixed to the inner quilted flap of the saddle by a button, as shewn at C; when not in use, it falls down between the two flaps, out of sight.

The figure B represents a cloth strap or fly of the colour of the coat, with a button to fix it to the great coat.

Fig. B.



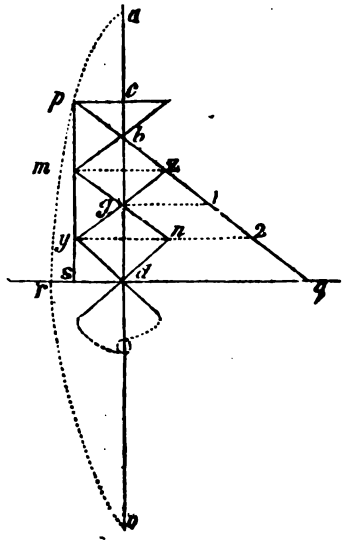
Attached to this strap is a brass ring, which is to be slipped into the spring attached to the saddle, when it is desired to retain the great-coat over the knee.

Both the spring and the ring should be fixed so as to be a little below the knee when you are seated in the saddle. It is best to disengage the ring from the spring before you dismount; but should this be forgotten, the ring will slip out upon being sharply pulled.

This contrivance I have found equally useful, both in warm as well as wet weather, as it prevents the coat from flying back, even when unbuttoned.

DEMONSTRATION OF THE CURVES DESCRIBED BY MARSHALL'S FIRE ESCAPE.

Sir,—In your 309th No. pp. 352, there is an enquiry by "A Constant Reader," as to the nature of the lines described by the ends of the levers of Marshall's Fire Escape, which he conceives must form "rather curious curves;" perhaps, therefore, he will be little surprised that they are nothing more or less than ellipses of different proportions.



In the construction of the machine, the four sides *mb*, *bz*, *mg*, *gz*, are equal, and the same holds good as to *any other parallelogram ygnd*; of course, *pz*, *mn*, and *mb*, *yz*, *dn*, are respectively parallel.

Let *apr* be the curve, described by a point *p*, at the extremity of the lever *bp*, *ad*, a perpendicular passing through the intersections of the levers, *b*, *g*, *d*, and *rq*, the horizontal line or base of the machine. Produce *pz*, cutting *rq* in *q*, and from *m*, *g*, and *y*, draw *mx*, *g* 1, and *yn* 2, parallel to *rq*—then since $mg = gz$, and $yd = dn$, we have, by parallels, $z1 = gx$; $1 \cdot 2 = gn$, and $2q = dn$, and $\therefore bq = bz + xg + gn + nd$; a constant and invariable quantity during the operation of the machine, hence *apr* is a curve, identical with that produced by a point *p*, in the right line, *pbq* regulated by the fixed poles, *b* and *q*, respectively moving along *da*, *dq*, being in fact the well-known mode of describing ellipses by the trammel.

As I have never seen, in any of the popular works of the day, a demonstration that the curves produced by the trammel are ellipses, I beg to submit the following, which as far as I know is new.

Draw *ps* parallel, and *pc* perpendicular to *ad*—then by sim. tri—$cp : qs = pb\ (rd) :: pq\ (ad) \therefore cp^2 : qs^2 = rd^2 :: ad^2$—(A)—Euc. B2, P5—$oc \times ca + cd^2 = ad^2\ (qp^2)$ $\therefore$ but $cd^2 = qp^2 - qs^2 \therefore oc \times ca + (qp^2 - qs^2) = qp^2 \therefore oc \times ca = qs^2$—by substitution in A we have $cp^2 : oc \times ca = rd^2 : ad^2$—a property of the ellipse.

From the above it appears that it is immaterial whereabouts in *pz*, produced either way, we place the tracer *p*, for the above demonstration will apply to all positions of *p* on *pz*, when *p* is at *b* and *q*, the ellipse becomes a straight line and when at *qb*-2 a circle.

In connexion with the above I should advise "A Constant Reader," to peruse the communications at p. 37, vol. 8, and p. 216, vol. 9, whence he may gather, that if a plane were fixed to any lever *pz*, &c. every point in it would describe ellipses, circles, or straight lines; and that these ellipses are in reality curtate and prolate interior Epecycloids, the diameter of a generating circle being one-half that of the base within which it rolls.

Since I wrote my last communi-

cation, I have stumbled upon one or two facts which intimate that there is some inconsistency in the result of the different methods of finding the radii of curvature of evolute curves. Although, I must confess, I still can see no error or wrong assumption as to any thing I have previously advanced. The evolute of a parabola is a parabola, then according to the usual definition of the radius of curvature, it should at the cusp be infinitely small. But it can be shown by other methods, that the radius of curvature of a parabola at the vertex is equal to the semiparameter, and that it is nowhere infinitely small, being a discrepancy which I cannot at present account for. As I have not at present my books with me, I cannot give the proportion of the evolute to the involute parabola, nor the general expression (given in most treatises on conic sections) for the radius of curvature, and writing from memory, there may (although I think not) be some error as to this point.

I am, Sir, Yours, &c.
R. C., Jun.

London, July 20th, 1829.

AN ACCOUNT OF EXPERIMENTS MADE AT DUMBARTON CASTLE BY PROFESSOR ANDERSON, IN CONFIRMATION OF HIS THEORY ON THE POWER OF ARTILLERY.

(*In continuation from last Number, p.* 7.)

The gun is an iron six-pounder, weighing 8 cwt. 90lb. The length of the bore is 4 feet 8 inches, the weight of the carriage is 1 cwt. 30lb., and its form that of a ship's gun. The platform is of wood, six feet of it are parallel to the horizon, and the remainder is an inclined plane. The height of the barometer about 29 inches 8 tenths. No wind. The heat of the air about 58 degrees; and the heat of the gun at each discharge, about 64 degrees. In the line of fire, there is a picket fixed in the ground at every 110 yards. The deviations were taken by measuring a perpendicular to the line of fire from the place where the ball first struck the ground; and according as they were upon the south or north side, they are marked S, or N. The gun was pointed by a gunner's quadrant, a spirit level, and a moveable triangle placed in the platform, with a wire which cut the object, the muzzle, and the breach of the gun. The loading, ramming, and pointing were studiously made alike, and they were performed by the gunner of the castle, who served in the artillery corps at Woolwich, and at sieges and battles in the last war.

No.	§ Ball 6lb.	Powder 4lb.	Elevation 15°.
1.	Range 2592 yards.	Deviation 56,S.	yards.
2.	Range 2669 yards.	Deviation 92,N.	yards.
3.	Range 2521 yards.	Deviation 49,S.	yards.
	Spheroid 12lb.	Powder 4lb.	Elevation 15°.
1.	Range 3210 yards.	Deviation 45,S.	yards.
2.	Range 3290 yards.	Deviation 29,N.	yards.
3.	Range 3250 yards.	Deviation 14,N.	yards.
	§ Ball 6lb.	Powder 3 lib.	Elevation 15°.
1.	Range 2246 yards.	Deviation 90,S.	yards.
2.	Range 2959 yards.	Deviation 36½,S.	yards.
3.	Range 2356 yards.	Deviation 34,S.	yards.
	Spheroid 12lb.	Powder 2 lib.	Elevation 15°.
1.	Range 2694 yards.	Deviation 10½,S.	yards.
2.	Range 2710 yards.	Deviation 21,S.	yards.
3.	Range 2699 yards.	Deviation 11,N.	yards.

Corollaries from the above Experiments and Theory.

1st. The range of the spheroid is greater than that of the ball, when the charge is the same; and consequently *it will have an advantage over it*, on account of the greater distance at which it will annoy.

2nd. Its deviation is less, and therefore it will annoy with more certainty.

3rd. Two pounds of powder give a range to the spheroid which is equal to

the range of the ball with three pounds: and consequently there will be a saving of one-third of the powder that is commonly used.

4th. The momentum of the spheroid is double that of the ball, which is fired from the same gun.

By the momentum of a projectile is meant the power which it has to act against, or to overcome, an impediment; and this arises from its quantity of matter and velocity taken conjointly. Thus the momentum of two hammers with equal faces, when striking the same body, will be equal: though the weight of the one should be six pounds, and that of the other twelve pounds; provided the velocity of the first is double that of the second. And if the velocity of both is equal, the momentum of the second will be double that of the first: and therefore the momentum of the spheroid is double that of the ball.

5th. When it is said that the momentum of the spheroid is double that of the ball, the supposition is that it goes straight through the impediment which it strikes, whether it be of earth, or stone, or wood. But this will seldom be the case, because if its fore part meets with unequal resistance from the body it strikes, the longer axis will turn round, and the shot will act against the obstacle length-wise, and consequently produce a greater effect than if it acted in the first direction. Now the resistance from the sides of ships is unequal, on account of the position of the bolts and nails, and different texture of the beams and planks, and a small difference in the firmness of the resistance, or in its position, will give a great deflection to the shot.

It is well known that large shot have a great advantage over small shot, because they break out holes in solid bodies in a greater proportion than their weights. The diameter, for instance, of a twenty-four pound ball is double the diameter of a three pound ball; and if both have the same velocity, the first will make a hole in a rampart or wall above eight times larger than the second, and it will penetrate to more than twice the depth. But if they strike wooden defences, or the sides of ships, the difference of the holes will be still greater, because the holes do not retain their original proportions on account of the springing of the wood. Every one will be sensible of this, who has fired cannon at a bulk-head, or who has examined a ship after a smart engagement.

In consequence of the greater momentum and size of heavy balls, ramparts are cut through by them which would suffer little from small balls; and they fracture beams and masts of ships, to which a great number of small balls would do little harm.

Now the spheroid will not only have a greater momentum, and make a larger hole than the common ball, but the hole will in general be more irregular, and so cause more splinters, and be stopped up with more difficulty on account of its shape.

6th. Firing with spheroids does not require more time, nor more accuracy, than the usual practice. Balls and grape-shot may be used as at present in quick firing upon troops, that are on a plane, or near at hand. Though the spheroid should soon be known to our enemies, the addition and the wadding may be kept secret, for a long time; and all improvements in war are of the greatest importance to the nation which uses them first. "Vary the instruments of destruction, and the species of terror," said an old General, "and I will gain every battle and take every town."

7th. If shells were made of a spheroidical form, it would seem, that they would produce two important effects—a double momentum, and a greater range than has ever yet been known.

From what has been said, three consequences may be drawn, which are of vast importance to this country at present.

A great saving may be made on gunpowder.

The power of our artillery may be doubled; all the guns in our navy may be converted, as it were, into those of double the force; a six-pounder into a twelve, a nine-pounder into an eighteen, and so on, to the thirty-two pounder, the largest in our navy, which may be converted into a sixty-four; and all this at a trifling expence, in a short time, and without making the least change in the guns.

Shells may be made in a similar manner, which by their momentum will destroy defences, that are impregnable at present; and which will burn ships that are secure in their harbours, because they are beyond the range of all the mortars that are in common use.

There are four practical maxims in books of artillery which render the above proposal so promising, that it would not be unworthy perhaps of the Board of Ordnance to extend a few experiments, that have been made with only a six-pounder, to guns and mortars of the largest size.

First Maxim. "All practical writers agree," says Robins, (vol. i. p. 146.) "in making the range of a twenty-four pounder, with the greatest allotment of powder, and at an angle of 45 degrees less than three miles."

St. Remy informs us, that the range of a twenty-four pounder, 10 feet in length, with a charge of 16lb. of powder, and at an angle of 45 degrees, was 2250 French fathoms, which is about 444 yards less than 3 English miles.

Second Maxim. By an extract from the books of practice kept at Woolwich, it appears that a 13-inch mortar, at an angle of 45 degrees, and charged with 30lbs. of powder, throws 12¾ inches in diameter to the distance of 3350 yards, the shell weighing 231lbs. and being nearly four-fifths of the weight of a solid iron ball of the same diameter.

Third Maxim. With proportional quantities of powder, and at an angle of 45 degrees, heavy balls range to a much greater distance than small ones. A thirty-two pound ball, for instance, will range near half as far again as a nine pound ball, their diameters being to each other nearly in the proportion of six to four.

Fourth Maxim. The range of a ball projected at an angle of 15 degrees, is half the range of the same ball, if projected with the same force at an angle of 45 degrees.—See Muller's Artillery.

Now, by the above experiments, the range of a spheroid thrown by a six-pounder with 4lbs. of powder, and at an angle of 15 degrees, is 3200 yards, which at an angle of 45 degrees, is, by the fourth maxim, 6400 yards, that *is, more than three miles* and a half; and, by the third maxim, the range of a spheroid from a thirty-two pounder, will be near six miles; which, by the first and second maxims, is double the range of balls that are thrown from the same guns.

[The preceding experiments are singularly at variance with the statement which we quoted in our last number from Colonel Macerone's unpublished work, particularly as regards the range of spheroidal balls, compared with the common circular shot. Perhaps Col. M., or some other of our military readers, will favour us with an account of these "subsequent experiments" which have demonstrated the fallacy of Professor Anderson's. It is observable that the spheroidal ball with which the Professor made his experiments, was in each case *double* the weight of the circular shot with which it was contrasted. But ought not the weight as well as all other circumstances, to have been precisely the same, to make the comparison accurate?]—ED.

CHEAP AND EASY METHOD OF MAKING SODA WATER.

Take forty grains of the carbonate of soda, put them into a common soda water bottle, which generally contains about ten ounces of water. Immediately afterwards, put into the same, thirty-five grains of tartaric acid, then cork it quickly. The acid and the salt ought to be used in crystals, as when in powder they are apt to seize upon each other before the bottle can be well corked, and so a considerable quantity of the carbonic acid gas which is evolved is lost.

INTERIM NOTICES.

We hope all that T. tells us of a projected reform in the London Mechanics' Institution, may prove true. It is possibly, not yet too late to save it from ruin.

The design of a Tractable Balloon, published in our 313th number, should not have been subscribed "P. B.," but "A. P.," the initials of Mr. A. Peacock, the author of this and many other ingenious contributions to our pages.

Communications received from Mr. Clampit—G. S.—W. A.—Petrus—Nautikus—J. B. C.—E. T.—J. G. N.—S. Y.—A Sincere Friend—J. O. B.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 318.] SATURDAY, SEPTEMBER 12, 1829. [Price 3*d*.

"All things without us, nay I may add, all things on us; are mere elements; but deep within us, lies the creative force which out of these can produce what they were meant to be; and which leaves us neither sleep nor rest, till in one way or another, without us or on us, this has been produced."—GOETHE.

OLD LONDON BRIDGE.

Fig. 1.

Fig. 2.

A DESCRIPTIVE ACCOUNT OF THE BRIDGES OVER THE THAMES, BY MR. C. DAVY.

No. 2.

OLD LONDON BRIDGE.

Architect—Peter of Colechurch—date 1176.

In the introductory paper on this subject, mention was made of the great variety of beautiful combinations of which the arch forms the basis, and by means of which architecture has been freed from the stiffness and monotony inseparable from an exclusive use of forms made up of straight and angular lines. It will be remembered that in the classification of this variety, the first list exhibited those combinations included under the *Italian* or *Roman* style; and the second, those which fall under the denomination of *Gothic*. The latter are so much more numerous and interesting than the former, as fully to justify us in awarding to our *Gothic* ancestors, the palm of a decided superiority in this branch of construction. It was only, however, in the erecting of ecclesiastical and baronial buildings that they evinced their skill in this respect; for, strange to say, there is manifest in all their attempts at bridge building, nearly a total neglect of those capabilities of the arch, of their intimate acquaintance with which, they left us so many other proofs. In our ancient cathedrals nothing is so remarkable as the general loftiness of the arches; but, in the old Gothic bridges, scattered throughout the country, the arches are almost always so near the water as to prevent any navigation from being carried on, and where the height or rise is considerable, a sub-arch is generally introduced in the intrados or soffit—a circumstance particularly observable in Old London Bridge, in some of the lesser arches—(*see fig.* 1 *and* 2.)

The pins, too, were seldom of any relative proportion, London Bridge, containing at one time no less than 19 disproportioned arches, with piles equally clumsy and rude.

The earliest account we have of a *bridge being erected* over the Thames, *bears the date of the* 10th century; but it is so obscure, that little reliance can be placed upon it. We have however the best of authority for stating that a ferry existed long prior to this across the river near the site of the present bridge; and that the ferryman, one John Overy, and his wife, at their demise, left considerable property which, by their care and industry, they had accumulated, to their only daughter Mary, together with the ferry itself. Mary Overy, it is said, converted this legacy and right to charitable uses, by establishing a House of Sisters near the church. At her death the property devolved to this house, and at its dissolution was converted into a college for priests, *who built a bridge with timber.* In consequence of the frequent repairs which this bridge required, it was taken down, and by the assistance of the citizens of London, rebuilt with arches of stone, which was the first time the River Thames was first graced with a bridge of any importance.*

It is evident, that for a long time, the art of bridge-building was little known in this country, for, although the bridge is stated to have consisted of "arches of stone," the major part of the superstructure, including the roadway, cut-waters, or starlings, &c.; and that portion of the bridge now occupied by a balustrade, was wholly of timber.

London Bridge was not erected for the sole purpose of forming a communication with Southwark, for we find that in the early part of the 11th century, it was used for defensive purposes, and regularly fortified with towers, ramparts, and castles. It was in 1008, the scene of several engagements, in which Etheldred the 2d. and Olaff were victorious over the Danes; but, in the last of these conflicts, it broke down. It is a curious fact, that although this took place in 1008, another bridge of wood is mentioned as being placed across the Thames, at this part, in 1016. In 1091, it was again destroyed by flood and tempest, but shortly after rebuilt. In 1136, it was considerably injured by fire, but

* Brayley's Londiniana, vol. 2.

repaired. In 1163, it was rebuilt of timber by Peter of Colechurch, who, thirteen years later, laid the foundations of the present stone bridge, which was completed in 1209. The architect died three years before its completion, and was buried in a chapel, in the centre pier of the bridge. The bridge, at this time, was covered with houses, which were in their turn consumed by fire in 1212, when upwards of 3000 people perished. In the winter of 1282, five of the arches were destroyed by the ice, and again repaired. In 1437, the principal gate on the bridge, (Southwark side) fell down, and carried with it two of the arches; and in 1471, Thomas Neville, in an attack upon the bridge, burned another of the gates, and a number of houses. In 1553-77 and 79, it was repaired and refortified. In 1633, 43 houses on the bridge were destroyed by a fire, which broke out near the church. In 1646, it was repaired, and the 43 houses rebuilt. In 1665-6, it was damaged severely by high wind. In 1666, the great fire destroyed the houses that were rebuilt in 1646. Between the years 1666 and 1686, nearly the whole of the houses were pulled down and rebuilt. In 1725, the gate-house was injured by fire, and, in 1750, the bridge assumed the appearance shewn in fig. 1, which however exhibits only 6 out of the 19 arches. In 1756, an Act of Parliament was obtained to clear away all obstructions and widen the arches by the removal of some of the smaller ones. When these improvements were carried into effect, they left the bridge nearly in the same state in which it now is, as represented in fig. 2, which exhibits the centre rch and two small arches.

Having now briefly mentioned in chronological order the more remarkable events in the history of this interesting structure, I beg to refer the curious reader for farther details of these events, to the following works:—Stow's Survey, Brayley's Londiniana, and Thomson's Chronicles of London Bridge.

I shall in my next describe *the construction of the old bridge*, and notice the reports of the committee appointed in 1820, for the purpose of taking into consideration the propriety of rebuilding the same.

(To be continued.)

ON INVERTING THE SLIDE IN THE GAUGING RULE

Sir,—I observe that your intelligent correspondent, Mr. Woollgar, at p. 23, of your last Number, refers to a paper in the quarto series of Nicholson's Journal, published in 1797, for the earliest notice with which he is acquainted of the important improvement in the use of sliding or gauging rules derived from inverting or reversing the position of the slider. I have, however, recently met with an earlier reference to that expedient, with which it seems a matter of justice that you should be acquainted.

About three months ago, a new edition of that useful little book, Hutton's Compendious Measurer, was published by Dr. Gregory. Among the additions and improvements which he has introduced, are some which relate to the use of the sliding rule. He gives some examples to illustrate the advantage, in many cases, of working with the inverted slide, and to one of them subjoins the following note, p. 291:—

"This method of solving such questions, by means of the inverted slider, was published (*first*, he believes) by the editor of the present edition of this work, in No. 4, of Whiting's Mathematical Delights, in 1794; and, among the questions to exemplify it, was the example here given. He also then prepared and announced for publication, a Treatise on the Sliding Rule, containing the application of the same method to many other problems in arithmetic, mensuration, and gauging. The examples given in this general scholium, are transcribed from the manuscript copy of that work, which its author preserves as a memento of early labour."

I do not imagine that Dr. Gregory cares any thing about the *reputation* of introducing such an improvement; yet, if he be really the first who announced the method, which seems

highly probable, the truth ought to be known.

I am, Sir,
Yours, &c.

Sept. 6, 1829. E. L. D.

CIRCULAR LOGARITHMIC SCALES.

Sir,—Mr. Woollgar, in his communication in No. 317, p. 23, appears to me to have misunderstood the nature of my improvement in the construction of logarithmic scales.

I proposed that the lines and numbers should be marked on the outside circumference, that is, on the *rims* of two or more *concentric wheels* revolving on the same axis. This idea, which occurred to me so long ago as the beginning of the year 1826, is, I conceive, essentially different from the marking them on the surface of a ring revolving round a circle, as they are in Mr. Lamb's Concentric Circular Proportioner.

When I first thought on the subject, I was wholly unconscious of any attempt having been made either to mark the lines on the surface or on the rims of circular instruments: both plans were suggested to my mind nearly at the same time, but considering the latter to be the best, I devoted my attention to that principally. The superiority over Mr. Lamb's instrument, I consider, consists in the practicability of making them almost of any size, yet perfectly manageable, of using the lines reversed as well as direct, and of being able to bring any two lines into contact that may be wanted.

At the time I wrote the communication for the Mechanics' Magazine, (Nov. 1828) I could not have considered the giving it a circular form as a new idea, having read in the dissertation on the rise, &c. of navigation, prefixed to the admirable treatise by Robertson, that the Rev. William Oughtred projected the lines on Gunter's scale into a circular arch, shewing fully its uses in a treatise first published in 1633.

I remain, &c.

ANTHONY PEACOCK

St. George's, East.
Sept. 7, 1829.

FIRE-EXTINGUISHING MACHINERY.

Sir,—In my last communication (vol. xi. p. 357), I alluded to the great extent to which fire-extinguishing machinery had been provided in London: and also briefly adverted to some of the causes which prevent the public from receiving all the benefit and security they are calculated to afford.

My intention, in the present instance, is, to resume that part of the subject, which not falling under the head of fire-escapes, I then purposely omitted; and also to lay before your readers some suggestions which appear calculated to increase the usefulness of that valuable machine, the fire-engine.

I before noticed the irregular and unequal manner in which both fire-office and parochial engines are scattered over this metropolis: and I may now add, that their sizes and construction are as irregular as their distribution. The want of something like uniformity in the connecting screws of the hose, if not in the size of the engines, has been a frequent cause of regret. One instance of this occurred a short time since at a fire in the neighbourhood of London. Two private engines, the only ones at hand, were brought, and one of them was quickly got to work: the hose, however, almost immediately burst, and the engine was disabled. Owing to a defect in the suction-pipe of the second engine, that could not be brought to bear upon the fire: which was, therefore, left for some time to rage with uncontrouled fury. Could *one* engine have appropriated either the hose or suction-pipe of the *other*, much good might have been done by one efficient machine. But, although the engines were about the same size, yet the screws being of different threads, this could not be done.

To prevent similar occurrences in future, standard screws for the hose of fire-engines should be fixed upon, of three or four sizes, for first, second, and third-rate engines. Three sizes will I think be sufficient for general purposes. I would recommend the screws for second-rate engines to have a water-way of about two inches diameter: and this size to be universally

adopted for fire-cocks. Each first and third-rate engine should be furnished with a connecting screw, for uniting their hose with that of the second-rate engines, or with the fire-cocks.

I am well aware that this plan cannot be immediately adopted without great expense; but the system is one which may now be partially adopted, and very soon become general. The numberless advantages, and the facility with which every contingency might be met, under this arrangement, must appear so evident, that I need not intrude upon your columns by their enumeration.

Another circumstance to which I would call the attention of your readers, and which has till lately been very much neglected, is the placing of plugs and fire-cocks in our streets. The former are now, I am happy to see, daily giving place to the more convenient latter; but even these appear too often to be erected without any consideration as to the propriety of their situation. Many fire-cocks and plugs have been erected in the most injudicious manner; in many instances, within a few feet, and sometimes even within a few inches of the waste-drain.*

There are so many local circumstances to be considered in determining the most advantageous situation for fire-cocks, &c., that to give any precise rule for that purpose would be impossible; the following general directions may however be followed with advantage.

In selecting a position for a fire-cock, &c., it should be kept in mind that the supply of water from it is available, in case of fire, throughout the whole of its course from the cock to the waste-drain; the greater, therefore, this distance, the greater will be the extent of such fire-cock's usefulness. It should be an invariable rule, for several reasons, to make the fire-cocks most numerous on the highest levels; and also to place them on the lower side of (and then as near as you please to) the sewer-drains.*

By carefully attending to this and similar circumstances, each supply of water may be rendered serviceable over a great extent of ground, and at a very considerable distance, perhaps, from the place at which the fire-cock is situated; this distance may in some cases be very considerably increased by covering over the sewer-drains with tarpaulings, with several of which, every parochial engine station should be furnished for this purpose.

To set an engine to work by suction from the water-course in London streets, it becomes necessary to bay up the water into a dam or pond, which can at present only be made of a sufficient depth by digging up the paving stones. This has ever been a tiresome and tedious job, but the improvements now taking place in our paving system will render it still more difficult, if not altogether impossible.†

It becomes necessary therefore to devise, if possible, some means of

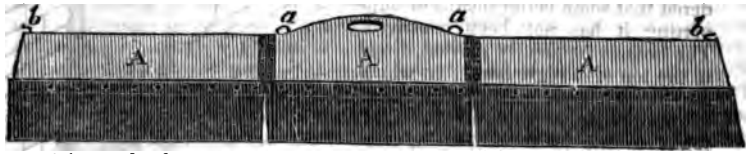
* There is a fire-cock before No. 10, Newgate-street, and also one before the Equitable Life Assurance Office, Bridge-street, Blackfriars; the water from both of which, passes direct from the nozle of the cock into the waste-drain immediately before them. I could adduce numberless similar *examples, but let this suffice.*

* Even the sewer-drains themselves appear in many cases to have been laid down without any regard to the propriety of their situation.

† The whole of the Poultry, and part of Cheapside, have been lately repaved. The method there employed, was, to remove all the old stones and a considerable portion of the soil beneath them. A firm bed was then made with broken granite, in pieces similar to those used in Macadamizing, levelled with coarse gravel. Upon this, new stones nicely cut, (technically called sovereigns) about 14 inches long, by 4 wide, and 9 inches deep, were carefully laid down, the gravel filling-in hitherto used, being omitted. When a considerable portion had been so far finished, a quantity of thin mortar cement was plentifully distributed over the stones, and urged into the crevices between them by repeated sweeping. The paving was then well rammed, and fine gravel strewed over it, completed the process. Although this, like all other *good* work, is in the first instance expensive, yet a most beautiful road has been obtained, and I am inclined to think that from its increased durability, it will eventually prove cheaper than the clumsy method hitherto employed.

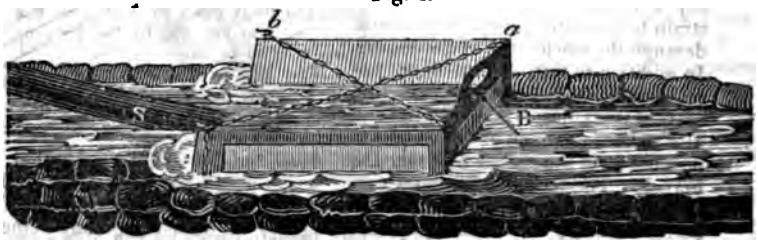
obviating the necessity of breaking up the paving. I have already had the honour of submitting to the consideration of your readers several plans for the attainment of this most important object. See vol. viii. pages 72, 190, and 412. Several of the fire-office engines are furnished with a straight board about four feet long, having a piece of canvas nailed to its lowermost edge; with this they bay up the water, but from its escaping at the sides, not to a sufficient depth to supply the engine, until some of the stones have been taken up. Upon this contrivance, I consider the following an improvement, because with it the water is stopped in its course, and being kept in by the sides, may be collected in a *much greater body* than by the former method. In lieu of *one* long board, I use *three* shorter ones, from about two to two and a half feet long, and about seven or eight inches deep, hinged together by canvas nailed over the joint. The lowermost edge of each board is furnished with a slip of canvas throughout its length, from about nine to twelve inches deep. Its construction if not already understood, will be rendered intelligible by the annexed sketch,

Fig. 1.



AAA are the three boards equipped with canvas as above stated. At the upper extremities of the central board, are two rings *a. a.* to which are affixed two chains. At the upper extremity of each side-board is a hook *b. b.* upon which the chains fasten to preserve the necessary position of the apparatus whilst in use, in which state it is represented by

Fig. 2.



The part of an engine's suction-pipe S is here shewn, the drain of this is supposed to be immersed in the body of water collected by the apparatus. From the manner of using the chains, it will be seen that the sides may be set to any width, *i. e.* at any angle with the back, that may be required. B is a prop, to prevent the force of the current from deranging the upright position of the back, or central board. The sides might also be preserved in the required position by similar props, in lieu of the chains, if preferred. With this stopping-board *the water may* in general be bayed up *sufficiently deep to admit* an engine *with a flat one-and-a-half* inch rose on its suction-pipe, to be set to work without displacing a single stone.

This, however, will in some measure depend upon the inclination of the road; for should the street be nearly on a dead level, even with this improved apparatus, a sufficient depth of water will not always be obtained; the removal of one stone will, however, in this case give the required depth. To this, the proverb of our Parisian friends, that "the first step is the greatest difficulty," applies with full force, for one stone having been displaced, the whole street may be speedily unpaved. It is, therefore, much to be wished that some arrangements were adopted, by which the

breaking up of the paving might in all cases be rendered unnecessary.

Among the many great improvements which were made in fire-engines during the seventeenth century, the addition of flexible hose was perhaps the greatest; as it admits of a stream of water being carried through long passages or over the tops of houses, and applied to those parts of a building where a fire is raging, and which, but for this invention, would have been wholly inaccessible to the utmost exertions of the firemen.

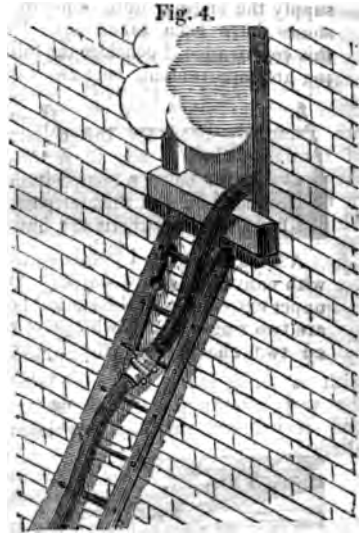
Having on several occasions witnessed the great advantages obtained by elevating the hose, I have wondered that some better means of supporting it has not been contrived.—The hose is frequently carried direct to the top of a high house, in which case the whole weight of the hose and column of water contained therein, tends to nip or pinch the hose together at the part which rests upon the parapet or window-sill, &c., from which it hangs. This nipping most materially increases the friction of the water-way, and consequently the labour of the men at the engine; to say nothing of the liability of the strain to burst the hose, or otherwise derange the mechanism of the engine. In addition to this, several hands are required aloft, to support the hose and prevent its falling to the ground, and also to keep as much of the weight as possible from the man who holds the branch. The hose is sometimes carried up a ladder, and sometimes supported by being tied with ropes; but in none of these cases is the nipping of the hose guarded against.

For the removal of this evil, several methods have suggested themselves, but I consider the following the most simple, cheap, and effectual. Upon a strong leather strap about two or three feet long, secure at one end an iron hook, *c*, (fig. 3.) at the other a square metal ring or eye, *d*, large enough to admit the hook to be passed through it.

Fig 3.

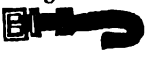
When it becomes necessary to elevate *the hose, screw a sufficient* quantity of it together, taking care that the last piece is a short or half length;* put the leather strap round the connecting screws, between the lugs or ears, and pass the hook through the eye, drawing the strap tight up to the screws. The hook may then be attached to the most convenient object that presents itself, such as coping-stones, window-sills or frames, ladders, &c. The ladder is, when at hand, the most eligible of all. In fig. 4, a piece of hose is shewn supported in the manner just described.

Fig. 4.



From this it will be seen that, the whole weight of the column of hose and water hangs upon the step of the ladder, the supporting strap being attached to the brass connecting screws of the hose, where it is impossible that any nipping can take place. Another modification, and perhaps a farther simplification of this simple apparatus, would be to attach the hook to a very short piece of strap with a buckle in lieu of the metal eye, as in

Fig. 5.



* When the stream is to be delivered at a distance from the point at which the hose is elevated, of course this arrangement must be modified according to circumstances.

A common strap, several of which accompany every engine, having been buckled round the connecting screws, between the lugs as before directed, the end of the strap is to be passed through the buckle on the hook-strap, fig. 5, when the hose may be immediately supported as before.

I am, Sir,

Your's respectfully,

WILLIAM BADDELEY, Jun.

August 15, 1829.

PEWTER COLLARS FOR LATHES.

Sir, — Having repeatedly heard those metals complained of, which are commonly used for the collars of turning lathes, I beg to recommend pewter as being a composition to be depended on for that purpose. This, I can do from experience, having in my possession, a lathe with a pewter collar, which has been in constant use for all sorts of work twelve years. The mandril being properly adjusted, the collar was cast around it, and afterward separated with a tenon saw; this completed the very simple process of fitting, and it has not required the least alteration since.

I am, Sir,

Your's, &c.

GEORGE CLAMPIT.

THE NUMBER SEVEN.

Seven is composed of the two first perfect numbers, equal and unequal —three and four; for the number two consisting of repeated unity, which is no number, is not perfect.

Hippocrates says that the septenary number, by its occult virtues, tends to the accomplishment of all things, is the dispenser of life, and fountain of all its changes; and like Shakspeare, he divides the life of man into 7 ages. In 7 months a child may be born and live, and not before; and anciently it was not named before 7 days, not being accounted fully to *have life before that periodical day*— The teeth spring out in the 7th month, and are shed and renewed in the 7th year, when infancy is changed into childhood—At twice 7 years puberty begins: at thrice 7 years the faculties are developed, manhood commences, and we become legally competent to all civil acts—At four times 7 man is in full possession of his strength; at five times 7 he is fit for the business of the world—At six times 7 he becomes grave and wise, or never—At 7 times 7 he attains his apogee, and from that time decays—At eight times 7 he is in his first climacteric—At nine times 7, or 63, he is in his grand climacteric, or year of danger; and ten times 7, or three-score years and ten, has by the Royal Prophet been pronounced the natural period of human life. The 7th year, as well as 7th day, was directed to be a sabbath of rest for all things; and at the end of 7 times 7 years commenced the grand Jubilee. Every 7th year there was a general release from all debts, and all bondsmen were set free.* Every 7th year the law was directed to be read to the people—and by that law, man was commanded to forgive his offending brother 7 times; but the meekness of the last revealed religion extended his humility and forbearance to 70 times 7. "If Cain shall be revenged 7 fold, truly Lamech 70 times 7." The Rabbins say, that God employed this number to perfect the greatness of Samuel, his name corresponding to the value of the letters in the Hebrew tongue, which signify 7; whence Hannah, his mother, in her thanks says, "that the barren had brought forth 7." The 7th son was formerly considered as endowed with pre-eminent wisdom; and the 7th son of a 7th son is still thought to possess the power of healing diseases spontaneously. Finally, perfection is likened to gold 7 times purified in the fire.

Z.

* From this law may have originated the custom of our binding young men to 7 years' apprenticeship, and of punishing incorrigible offenders by transportation for 7, and twice 7 years.

HOW TO WEAR SPECTACLES.

We copy the following sensible directions on this head from a Treatise on the Human Eye, by Mr. West, successor to Mr. Adams, the eminent optician. It is an instructive and amusing little work, and very appropriately addressed "To all who value their sight."—"In the proper use of spectacles, there is no circumstance of more importance than their position on the head. They should be worn so that the glasses may come as close to the eyes as possible without touching the eye lashes; they must also be so placed that the glasses may be parallel to the paper when held in an easy position; to accomplish this, let the sides of the spectacles bear upon the swell of the head, about midway between the top of it and the ear; the eyes will then look *directly* through the glasses to the paper, and make the most advantageous use of them, instead of looking *obliquely* through them to the paper, as in those cases still so numerous, where persons place the sides of their spectacles in contact with, or very near their ears; in which position they produce a distorted image on the retina. The sides of the spectacles should also be placed at an equal height upon the head, and the hands being applied to the *points* of the sides, will generally direct their equal height, as well as allow of their opening to their full extent without injury."

RUINOUS INEQUALITY OF THE ENGLISH SYSTEM OF ACCOUNTABILITY.

Sir,—With referring to your correspondent's letter, Hindostanee, No. 317, I beg to say, that the decimal account would apply to all the colonies without exception. Were England to adopt the accountability of the United States, France, and Russia, the East Indian, West Indian, Canadian, and all other colonial duties, would consequently be reduced one-sixth. The English, United States, French, Russian, and all other foreign duties, would, *to the English export trade*, be also reduced one-sixth.

The foreign monetary exchanges are calculated in silver. Since 1818, the English have been calculated in gold. The French exchange is 25*d.** the rupee sicca.

In France, silver is to gold as 792 pence to 12,276 pence.
In England, ... 792 pence to 11,214 pence.

The English pound troy of gold is worth 1,062 pence more in France than in England.

In addition, though the French pound of silver, bread, meat, silk, &c., is heavier than the English pound of bread, meat, silk, &c., the English money is, most unaccountably, heavier than the French. Therefore, the public were *officially* informed this last week, that 35,695 English expend annually in France 95,885,500 francs: and 6,680 mechanics are enumerated; for whose expenditure of intellect there is no French calculation. The returns from Italy, Switzerland, the Netherlands, &c., have not yet been published.

The public are, I presume, very much indebted to Sir George Clerk, and the other Commissioners of Weights and Measures, for the *unity* pint measure; though wheat continues to be bought and sold in London *per quarter—in Liverpool per 70* pounds—throughout Ireland per 280 pounds. Should not corn be universally sold by weight, with reference only to its measure of capacity?

Coal is bought by weight, and sold by measure. It was stated on the 6th of May last, to a Committee of the House of Lords, that were coal sold by weight, its price would be considerably reduced. A question was then asked as to the power of machinery to weigh them. The laden galley which Archimedes raised, to the astonishment of King Hiero, was, for aught we know, a collier.

Were the minimum price of the colonial lands 10 pence, or 1 shilling the square; with every transfer of 100 shillings national debt or stock,

* 25 pence, equal 2*s.* 5*d.* French weight.

there would be a transfer of 100 squares of land. In the United States, stockbrokers are also land-agents.

It is not from the *Chaire* of the French Mechanics, that Baron Dupin should exult at the English *unaccountable accountability*. In departing from his professional subject, the learned President does injustice to his generous disposition and cultivated understanding. England has security, landed security for her debts, while the only lands belonging to the French Treasury are those in the uninhabitable Guienne.

By the "Decimal Account," as the wholesale prices would be calculated *per centum*, pounds, pints, feet, and centifoot, the retail expenditures and profits would at all times be accounted to the public—to which public I request you will submit the account in your most useful Magazine.

I am, Sir,

Your most obedient,

And humble servant,

Sept. 7. T.

THE ENGLISH DECIMAL ACCOUNT.

SCALE.—*The Standards of Weight, Capacity, and Length.*

Scale of weights and measures.—1, 2½, 5, 10, 25, 50 —— 100.

Pounds.....	Quintal 100.	Pound 100 drams. Dram 100 grains.
Pints.....	Hundred 100.	Pint 100 drams. Dram 100 grains.
Pence	Pound Sterling (*avoir-du-poids*).....	1,000 ounces.
Feet.....	1 Cube.....	1,000,000 centifoot.
	1 Square.....	10,000 centifoot.
	1 Linear	100 centifoot.
Pound sterling (*avoir-du-poids*)		100 shillings—or 10,000 grains.
Land Measure.—Line.....		100 feet. Square 10,000 feet.
	Mille.....	1,000 feet.
	League.....	10,000 feet.

NOTE.—The Hundred weighs 2 feet cube, or 2,000 ounces of distilled water; or 100 pounds of Alcohol. There are 20 Hundred to the Marine Ton.

The French Mint Standard is 90 silver, 10 alloy=100. Gold 15½.

Astronomers and Geographers calculate 365,184 feet to a degree.

The foot is the *Basis*, of weight, capacity, and length. The yard is 300 centifoot.

PIGMY TRIBES.

The smallest mammiferous animal yet known is the minute shrew, (*sorex exilis*) which weighs but half a drachm; the smallest animal of the stag kind is the pigmy musk, the legs of which are but two or three inches long, and no thicker than a tobacco-pipe; and the smallest of birds is the trochilus minimus, a species of humming-bird, which weighs when dried no more than thirty *grains!*

LARGE MOTH.

A friend at Arracan informs us, that he has caught a moth, which measures from the tip of one wing to the tip of the other, ten inches. Both wings are beautifully variegated with the brightest colours. Unless we are mistaken, this is the largest moth upon record, exceeding in dimensions the largest in the British Museum, which, we believe, measures about 9 inches from tip to tip. —*Madras Paper.*

ROUGH NOTES ON TOWN,

By a Traveller.

(Communicated for the Mechanics' Magazine,)

All the entrances to London are with one exception *architecturally* insignificant and mean. Whether you enter it from the north or south, east or west, by land or water, (we must wait yet awhile it seems before we can say by *air* also) 'tis all the same. There is nothing grand in the way of building; nothing to fix the gaze of the passenger, or to excite his expectation; nothing to denote to the eye that you are on the threshold of the Queen of Cities—

" ——————Babylon of old,
Nor more the glory of the earth than she;
A more accomplished world's chief glory now."

'Tis a spacious river, to be sure, the Thames; but what is any river, however spacious, without banks of corresponding magnificence? All the way up from Greenwich to Westminster Bridge, a distance of about six miles, there are not half a dozen buildings of magnitude; neither is there any road-way on either side for carriages, horsemen, or pedestrians; only one or two *bits of terrace*, fronting the stream, such as the Adelphi. It seems as if the people of London, proud as they affect to be of their noble river, only liked to look at it askance down their dingy streets and alleys.

I am told this would not have been the case, could Sir Christopher Wren have had his own way at the rebuilding of London, after the great fire. Pity, that Sir Christopher should have lived in an age so little able to appreciate his enlarged views. Pity (almost) that so admirable an *opportunity* for a great improvement was not reserved for *other* times! (I cannot in sincerity say *our own*).

There was a great talk after the Peace, of making Hyde Park Corner *the grand entrance* to London; there was to be a triumphal arch, triumphal statues, and I don't know what, all triumphal. The spot too—the summit of a long and broad ascent—was admirably adapted for all these things. But what have *fourteen* years, and an *expenditure little short of* £100,000, actually produced? No triumphal arch at all—*across the road* at least, which was the thing meant; only on one side a gate-house or lodge to an unseen palace, situated somewhere behind in the purlieus of Pimlico—and on the other, a gateway to Hyde Park, within which an ill-shapen piece of nudity called a statue of Achilles, is seen holding up a shield for daws to peck at. Talk of "triumphal" erections! Two side-gates and a naked Greek to watch them!! One is almost tempted to say, that if such be the triumphs of peace, the sooner war comes again the better.

To be sure, there is no odious toll-gate to obstruct your progress at this point as heretofore; and herein doubtless there is consolation. The authorities have discreetly taken care that there shall be nothing to prevent people of taste and delicacy, hurrying as quickly as possible, past the oddities and nudities of the place.

Yet, to speak truth, there are two or three things in the details of Hyde Park Corner, worth lingering a few minutes to examine. The Royal Lodge, considered by itself, and not as part of a grand entrance to a great city, is altogether a beautiful structure; and both on this building and on the opposite gateway there are some masterly sculptures by Henning.*

Turn we now to the other entrances to this mighty Babel. Which shall we pronounce the most interesting to the lover of the picturesque? Whitechapel and its shambles—or Shoreditch and its rags? The sombre and crowded Borough, or that paradise of costermongers, St. George's Fields? Tyburn Corner is only a little better than Hyde Park Corner, and the City Road not nearly so good.

The "one exception"—the only

* Since these notes were penned, the house of the Duke of Wellington, which adjoins Hyde Park Gate, has been rebuilt in a very noble style; and on the opposite side of the road, a little lower down, a new St. George's Hospital is in the course of erection. Both unquestionably redeeming features; for which however we are indebted not to national committees of taste, but to individual spirit.

one—to this general insignificance and meanness, is the entrance by Blackfriars Bridge. A straight and spacious road of a mile in length, flanked by houses generally of a first-rate description, leads by a gradual and easy ascent to the summit of the bridge, and when you reach that summit—but not till then—London bursts on your view in all its plenitude of domes, spires, towers, turrets, bridges, shipping, &c. Were the road onwards only cleared from the buildings of Fleet Market (which it will now soon be) and extended over Saffron Hill to Spa Fields, (as has been often proposed) there would be nothing in any city I have ever seen, to vie with the view from the summit of Blackfriars Bridge, in extent, variety, and grandeur.

The road which leads to Waterloo Bridge is as long, as straight, and as broad as that by which you reach Blackfriars; but the houses which have been hitherto erected on this line, are mostly of mean elevation. The view of the city too from Waterloo Bridge, is by no means so good, being less central, and by far less comprehensive. But enough perhaps of approaches; let us now walk into the city itself, and take note of what the spirit of improvement is effecting within it.

And, first, as we have spoken of the removal of the Old Fleet Market, let us see what is to come in its place.

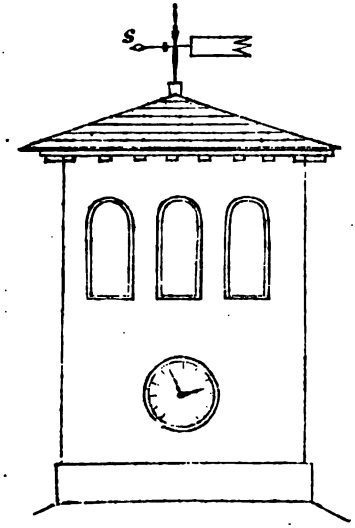
The *New Fleet Market*, or as it is proposed to call it, *Farringdon Market*, in honour of the ward in which it is situated, has been constructed after the plans and under the direction of a gentleman who holds the appointment of City Architect, and who is said to have previously travelled all over Europe, at the expense of the Corporation, in search of models for his guidance. It is unreasonable perhaps, to look for much at any time from persons who are men of talent *ex officio*; still it might have been expected that an individual who has been at so much pains to make himself master of the task assigned to him, and who has experienced the encouragement of such generous and confiding patrons, would have succeeded a little better than the City Architect has done in the present instance. The market is of a quadrangular form; three sides are occupied by shops, with open double roofs in the Italian style; the fourth is left open; and so far there is no fault to be found with the general plan. But it so happens, that the ground is an inclined plane, with a rise greater than that of Ludgate Hill; and in the management of this locality, the City's travelled Architect has blundered egregiously. Instead of making the chief entrance to the market at the bottom of the plane, as it ought naturally to have been, he has been pleased to make it at one of the sides! Hitherto it has been a received rule in architecture, that the two wings of every building should be on the same level: but here we have one wing some twenty feet higher than the other. This new style of the City Architect, not only looks ill, but will be found productive of serious inconvenience. The market-carts and waggons, which might have entered at once and with ease from the broad street that will be formed by the removal of the old market, will have to go up a narrow street called Stone-cutter Street, (narrow for such a purpose) and then turn at a sharp angle into the market—as awkward a mode of entry for heavily-loaded conveyances as it is possible to conceive.

Again—although, as before stated, three sides of the square are occupied by shops, only one range of these shops, that on the lower side, have open fronts towards the square of the market. The shops on the two other sides have not even windows looking into the square; only small gratings near the roof of each, for the sake of ventilation. The dull, prison-like effect which this blocking up of two sides of the quadrangle has on the general aspect of the market, may readily be conceived.

It may be said in defence of this arrangement, that it became necessary in consequence of these ranges of shops being *double* ranges. But could not the shops have been placed back to back, as well as face to face? Would it not have been better, on every account, that they should have been so? Both air and light—two matters of the

first consequence in a market for fresh provisions—would have been gained by such a reversal of the arrangement.

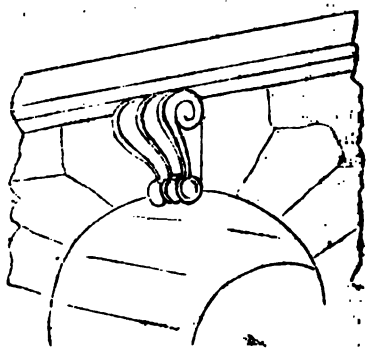
Over the centre of the range of shops fronting the entrance to the market, there is a turret with a clock in it. I am tempted here to give a little sketch of this turret, to shew for the sake of what prettinesses Corporations Architects will journey into foreign lands.



Continental, this decidedly is, but very paltry notwithstanding; a genuine production of that very classical school of which every German toy-shop furnishes an abundance of specimens.

Apropos of this turret; although the general plan adopted in these buildings has been to raise the roofs on arches, it seems that in the case of the turret, the Architect was tempted to try whether a straight course of bricks would not be as strong as a curved one. Luckily, the work broke down in the course of the experiment. Corporation Architects should read as well as travel.

In addition to the large side-entrance to the market, there are a number of smaller ones at different parts for customers—one of which fronting the old market is surmounted (for the show's-sake it would seem) by rather an elegant gateway. One wonders *where the City's Wren* could have picked up so nice a design. I hope to be excused, however, for pointing out to the gentleman a fact of which he seems not to be aware—that key-stones are like arches, intended to give strength, and not even when of a Roman nose shape, to protrude from the buildings to which they belong. To make this grave matter a little clearer, I must beg leave to have again recourse to my pencil.



The fault here must, I presume, be evident. When such a scroll shape is given to a key-stone, it is usually in order to impart to it a greater appearance of stability; but the stability is wasted in supporting nothing in this instance.

(To be continued.)

ON THE THEORY OF THE UNIVERSAL VITALITY OF MATTER.

[We published in our 273rd Number, a letter from Mr. W. H. Farquhar, in which, after stating certain objections that occurred to him *a priori* to the theory of the universal vitality of matter broached in France by Dr. Edwards and others, and since advocated in this country by Mr. Brown, he intimated that he had "in conjunction with one or two scientific friends, a mode of scrutiny in contemplation which would completely put the reality of Mr. Brown's discoveries to the test." We have been in anxious expectation of receiving the result of this scrutiny, and hope we may still be favoured with it. Observing, in the mean while, that a contemporary journal (the Literary Gazette) has just contributed the aid of its ex-

tensive circulation to give wider currency to the speculations of Mr. Brown, without the addition of a single qualifying or cautionary remark; we are induced to republish, by way of counteraction, a very able article which has appeared on the opposite side of the subject, in a recent Number of the American Journal of Science. We give as much as we can spare room for this week; the rest shall appear in our next.—Ed. M. M.]

The mystery of life, or the cause of sensation and voluntary motion, has been a subject of the deepest interest in all ages of the world. The curious and the learned have instituted the most diligent inquiries to discover whether the hidden principle is an emanation from the divinity, that is, a supernatural gift; or whether it resides in the organized structure, by some particular disposition and consent of parts; or whether each particle possesses inherent powers of life in its separate state, and thus spontaneously arises from decaying forms to engage in new scenes of activity.

Within a few years, from some investigations with the microscope, a theory has arisen, which maintains that this mysterious principle is inherent in the elementary forms of matter, and that they assume new shapes, and revive in their primitive activity, whenever death changes their aspects.

These doctrines, adopted in their full extent, restore the dogmas of the metempsychosis, and the chances of Democritus, and, by vulgar induction, end in atheism. Without the dignity of that system of which Epicurus, Lucretius, Pliny and Lucian were disciples, they fall into the materialism of Leibnitz, who considers "each monad or atom possessed of perception and appetite. This appetency produces an internal principle of alteration—hence the sympathies and affinities, the combinations and the forms of bodies."

The Epicurean theory, although it deemed matter eternal and insensate, and that its particles, by jostling for ever, had at length adhered in masses, ultimately forming the world itself, inhabited by animals, and clothed with vegetation; yet, it taught that it was operated upon by an immaterial divinity, and that life was imparted by a divine invisible power, who ruled over all.

In later times, Sir Isaac Newton built a noble superstructure upon the principle asserted in the Mosaic account of the creation—that all things were made by an omnipotent, immaterial, intelligent being; that he established those immutable laws by which the universe is regulated and governed; and that he imparted animation to creatures by bestowing upon them the breath of life.

But Dr. H. M. Edwards, an English physician in Paris, and Dumas, Dutrochet, Prevost, and others, have ascertained to their own satisfaction, by some elaborate discoveries with the microscope, that the elementary, organic, constituent parts of animal and vegetable bodies, inherently and independently possess the vital principle; that spirit of life, which has hitherto been veiled in mystery. Edwards describes the animal body as "built of animalcules, as a pyramid is built of bricks," being a congeries of countless millions of organized units, "each capable of living in a separate state, and perhaps exercising the functions of individual life, while incorporated in one being." He teaches that these monads or globules, being of the $\frac{1}{5000}$ part of an inch in diameter, by one arrangement form the various tissues and fibres of the animal structure; and by another arrangement, spring up in the glowing colours and varieties of vegetable life, and that when death passes upon them, and decomposition separates the parts, elements which were before parts of some animal, become vegetables, or if it so may chance, vegetable atoms awake to life as animals.

These inferences rest on the following experiments:—

Dr. Edwards examined a piece of animal substance macerated in water, and immediately perceived a number of white vesicles moving about with great rapidity. These he considered to be animalcules of the tribe monades. He observed that these monads lost all power of motion when the water evaporated. "If water were added *immediately* after the cessation of motion, they again began to move, but if allowed to remain dry for a short time, they never recovered the faculty of locomotion." He also observed, that "whenever they adhered to the sides of the glass, they exhibited every appearance of vegetable life."*

The same experimenter macerated a leaf of the horse-chesnut, and "as soon as the particles became detached from the margin of the leaf, they were seen

* Westminster Review, No. 13; Jan. 1827.

to put themselves in motion;" thus showing that when the tissue of plants is decomposed in water, its component organic parts possess independent life, and spontaneous motion.

Another example, though not included in those mentioned by Dr. Edwards, is still more surprising, as it would suggest that the degree of heat which destroys life in visible objects, had the effect, while life was in its invisible state, to aid in its development. "A potato was boiled in water until it became of a mealy consistence. It was closely covered in a glass vessel, and a drop of the water was examined twenty-four hours after, when it exhibited innumerable animalcules in great activity."

From these examples, they conclude that sensation and voluntary motion reside in matter; that however minutely the parts are dissociated, they still possess a principle of vitality; "that death does not destroy their susceptibility; and that life and matter are coexistent, and from everlasting to everlasting."

These data, and the inferences deduced from them, being at variance with those visible facts, and those unerring, invariably recurring rules called the laws of nature, an inquiry respecting them is justified—

1. Whether there is not a fallacy in those appearances which are assumed as first principles?

2. Whether life exists in brute matter? And

3. Whether inert matter, or particles specifically animal or vegetable, can spring to life, in natures remote from, and opposite to, their own origin?

FIRST—*Is there not a fallacy in those appearances which are assumed as first principles?*

Microscopic discoveries are peculiarly liable to error. They require great acuteness and accuracy of sight, and the contradictory conclusions made by the most exact observers with the microscope, render it of doubtful validity. As it would be unfortunate to build a principle in physiology upon an optical illusion, those appearances which have been adduced should be received with great caution, because, if the first point is wrong, every succeeding step must be erroneous, and all further reasoning upon it would be confirming the deception.

A fallacy may therefore be suspected in those appearances which were considered as voluntary motions. It is worthy of remark, that *the monads were viewed through the refracting* medium of water, and that many of the fibres retained their thread shaped forms, while others, still farther divided, were reduced to points or globules. Being so attenuated as to be scarcely visible, the progress of decomposition producing a further separation of parts, and moving them by chemical action, might easily cheat the senses with the appearance of animation. While the motions accompanying a chemical process are visible to our unassisted sight, they excite no surprise. A piece of sugar rises and falls in a glass of water, bubbles agitate the mass with motions which appear to be inherent, but these phenomena are not suspected of bearing any relation to life. The motions of the eye stone in a plate of vinegar have been attributed to animal life; but as it is a calcareous stone, the motions are obviously referable to the action of the acid upon it, which disengaging a gas, impels it mechanically from side to side. Gaseous particles, disengaged or acquired at the precise point of time when those macerated materials were under examination, by effecting a moving impulse upon them, aided by the refraction of the water, and the minuteness of the particles, might produce a resemblance to life, although by no means a demonstration that they possess vitality. Further proof is unattainable, as the subject eludes further inspection.

We are therefore warranted in doubting the correctness of the inference, that the motions discovered by the microscope were attributable to animal life; and we are justified in believing that the senses were deluded by appearances resembling life which were not life; inasmuch as the circumstances under which they were detected, render the evidence of the senses imperfect; and as the conclusions drawn from the analysis are unsupported by analogy throughout the visible creation.

But if no doubt rested upon the fidelity or capacity of the human senses in this inquiry, and if it were granted that man with his excellent perfections, and the oak with its duration and grandeur, are composed of the identical particles which form the ignoble reptile, and the poisonous weed; yet we are assailed at this point of the inquiry with the

SECOND QUESTION—*Whether life exists in brute matter?*

If animation were inherent in matter, and the presence of water were to awaken the principle, why should it leave the monads as soon as it is withdrawn? and why do they not revive on

its reapplication? Mr. Edwards expressly states that "they never recover the faculty of locomotion, unless the water, after evaporation, is immediately restored." It is a contradiction to say, *that life is inherent in matter*, when, by changing its circumstances, it becomes deprived of it, and *cannot regain it*. What is that but death in its common acceptation? The term death implies a change from the power of acting to total inactivity. It implies an utter and irrecoverable extinguishment of sensation, and the faculty of motion. Inertness expresses the state of matter without life, and without any innate principle of revivification.

If the water were not withdrawn, would those particles of matter remain stationary, or would they increase in dimensions; or would they change into other living beings; or form other and unknown combinations? Whatever their shape or location, whether they remain units for ever, or experience transformation, *if they are indued with an inherent living spirit*, they must be immortal. A thing possessing an innate principle of vitality cannot be dispossessed of it, unless it is annihilated. If annihilation can dispossess a material monad of existence, the same principle may apply to masses of matter, and the balance of the globe be destroyed by its operation. The order being disturbed which rules the planets in their spheres, and establishes the symmetry of the universe, the whole might rush into chaos, or evanish into nonentity.

(To be continued.)

LITERARY COBBLER.

In Weber's Northern Antiquities is to be found the following instance of literary application, which, taking all circumstances into consideration, is perhaps without parallel:—Hands Sacks was born in Nuremberg, in the year 1494; he was brought up to the trade of a shoemaker, but at 14 began the practice of writing and continued to make verses and shoes, plays and pumps, boots and books, until the 77th year of his age. At this time he took an inventory of his poetical stock in trade, and found, according to his own narrative, that his works filled 32 folio volumes, all written with his own hand! and consisted of 4,200 mastership songs, 208 comedies, tragedies, *and farces (some of which extended to seven acts); 1,700 fables*, tales, and miscellaneous poems; 73 devotional, military, and love songs; making a sum total of 6,048 pieces; great and small! Out of these we are informed he culled as many as filled three massive folios, which were published in the years 1558-61; and another edition being called for he increased this to six volumes folio, by an abridgement of his other works.

ADVANTAGE OF A "LITTLE KNOWLEDGE."

It is related of Mr. Cheselden, well known as having been surgeon to the Queen of George the Second, that going into an obscure country town, he found a blacksmith, who with the best intentions and the utmost confidence, was in the habit of performing the operation for removing the cataract.—Pleased with his talents, Mr. C. communicated some instructions, and at a future time inquiring what had been his success, the man replied, "Ah! Sir, you spoilt my trade; for after you explained to me what I had been doing, I never dared to try again."

CURE FOR THE STING OF A WASP.

It is stated in a country paper, that the juice of an onion is an instantaneous cure for the sting of a wasp. The writer says, "I have seen it tried with the smallest scallion taken from a sallad. The effect is instantaneous in curing the pain, or preventing it, if within reach at the time."

INTERIM NOTICES.

"Admirator" can only take out a patent for "the additions" exclusively, not for the old machine *with* the additions, and that he may do immediately.

The continuation of Dr. Lardner's lectures is deferred for want of certain diagrams until our next.

A Mr. H. Cox who informs us he has "invented a machine which is propelled by its own power, and will be so until worn out;" wishes to know "if this be what is called Perpetual Motion?" What can wear out cannot of course be perpetual; but if Mr. Cox has succeeded to the extent he states, we make no difficulty in assuring him of the laurel crown.

Communications received from Henry D—J. W. (Tullamore)—Mr. A. Mason—Gilbert—P. S. D.—B. H. B.—Mr. Harrison—Z.—A Member of the Bath Mechanics' Institution.

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"By presenting excellence before the people, you gradually excite in them a taste and feeling for the excellent."—LESSING.

STIRLING'S HOUSEHOLD AND FLOATING FILTERS.

Fig. 1.

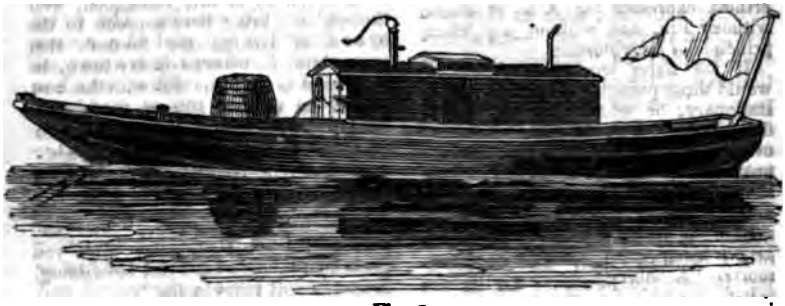


Fig. 2.

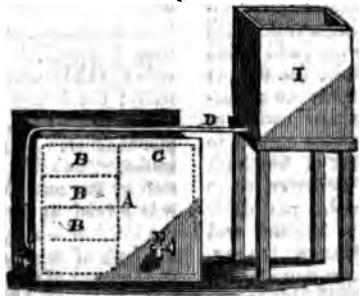
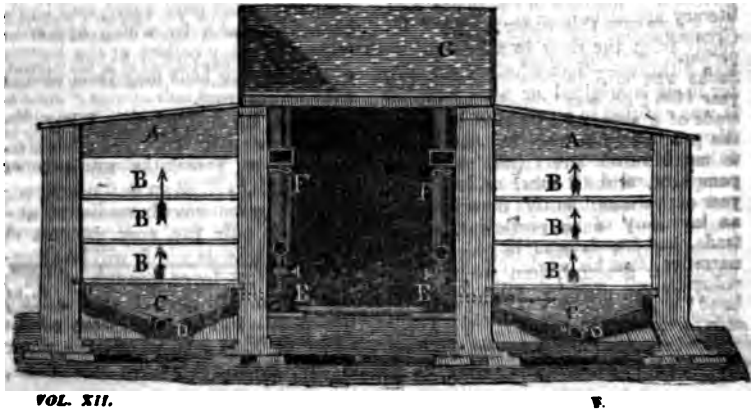


Fig. 3.



STIRLING AND SON'S HOUSEHOLD AND FLOATING FILTERS, AND PLAN FOR FILTERING WATER IN LARGE QUANTITIES.

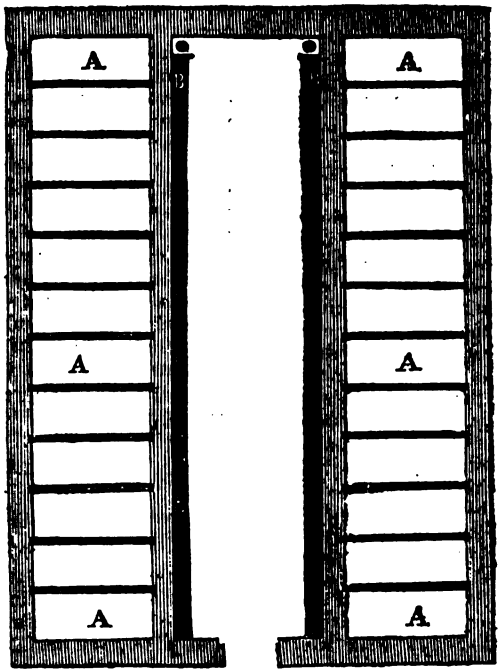
We mentioned some months ago, the taking out of a patent by Messrs. Stirling and Son for a "Slate Filterer;" and though we expressed our opinion that the invention does not possess any such feature of originality as should make it the subject of an exclusive privilege, we admitted unreservedly "that an arrangement of filtering materials, such as they propose, is a very good one"—an admission founded on "experience," and that experience considerable. While passing down the river the other day, our attention was recalled to the filter of these gentlemen, by the novel spectacle of a barge (see fig. 1.) laying alongside a foreign vessel, and at one and the same moment, pumping water out of the river, filtering it by means of a "Stirling Filter," and discharging it into the foreigner for its use during a long voyage. We enquired what was the additional expense incurred by thus supplying a vessel with pure instead of filthy water, and found it to be so inconsiderable, (2*s.* 6*d.* per ton) that it cannot possibly be a matter of objection with any owner or captain who has a proper regard to the health and comfort of his ship's crew. We thought, moreover, there was so much merit in this particular application of Messrs. Stirling and Son's Filter — for strange to say, though nothing has been more talked of lately than the abominable impurity of the Thames water, no one ever adverted to the case of the poor sailor, for whose use this water is lifted directly from the river in all its primitive filthiness—that whether the Filter itself is original or not— whether it was entitled to a patent or not—the Messrs. Stirling and Son are of all Filter Manufacturers (now a numerous host, and all more or less meritorious) pre-eminently deserving of praise and encouragement. We therefore now proceed to give a more particular account, than we have yet done, of the mode of filtering which these gentlemen are so actively employed in introducing into general *use.*

Fig. 2, represents one of Messrs. Stirling and Son's Filters in its simplest shape. It is constructed of smooth slabs of slate; a substance recommended by its superior cheapness, cleanliness, and durability, being not liable, like metal, to corrosion, or, like wood, to rottenness. These slabs are cemented together at the joints by strong mortar or other durable cement, and are braced together by iron rods, which pass through them near the joints, and are secured by nuts screwed on the outside. The water to be filtered is collected in a cistern or reservoir I, whence it is conveyed by a pipe D into the Filter, which is placed on a level two or three feet lower. The Filter is divided into two principal compartments by the partition A; one (BBB) containing the filtering materials, and the other (C) the pure filtered water. The compartment BBB is divided into four parts by perforated plates; the first or lowest is left empty; the second and third are filled with river sand (that which Messrs. Stirling and Sons use is of a peculiar description procured from Scotland, but perhaps any fresh water sand would answer equally well); the fourth with sand and carbonaceous matter, and the fifth with pieces of iron slag. The water is introduced into the first or empty division by the service-cock F; from this it is forced up by the pressure from the head of water, through the filtering beds of sand, slag, &c.; and from the topmost of these it passes off in a state of great purity into the compartment or cistern C. E is a cock for drawing off the pure water, and G, H, cleansing cocks, by which any sediment that may collect at the bottom of the filtering beds may from time to time be removed.

When we noticed this Filter formerly, we observed, that "water, whether it percolates upwards or downwards, will go on to the last parting with extraneous ingredients, and that it is only the very grossest of these ingredients which will be arrested in the first layer through which it passes," or (we should have added) which will fall to the bottom of the empty division into which the water is first introduced. We still think,

therefore, that in merely providing the cleansing cocks G, H, to carry off such sediment as may collect at the bottom of the Filter, Messrs. Stirling and Sons have not made sufficient provision for obviating the foulness which the Filter must necessarily contract from use. The filtering beds will, we are quite certain, have to be frequently renewed, or where that cannot be readily accomplished, taken out and well cleansed, which will be best done with a broom under a fall of water.

Fig. 4.



Figs. 3 and 4, represent a plan which Mr. Hollis, the Civil Engineer, has arranged in conjunction with Messrs. Stirling and Sons, for filtering water in large quantities by means similar to those which they have adopted in their Household and Floating Cisterns. Fig. 3, is a transverse section, and fig. 4, a plan of this Public Filter. G. fig. 3, is the foul water cistern; CC, chambers for receiving the foul water by the service-cocks EE, and supply-pipes FF. BBB the filtering beds. AA pure water cisterns, DD cleansing-pipes. In fig. 4, AAA exhibit the arrangement of the filtering beds, and BB the pipes for supplying them.

The same objections which we have made to the sufficiency of the cleansing means provided in Messrs. Stirling and Son's ordinary Filter, will apply to this plan of a Public Filter. The cleansing-pipes DD would only carry off the grosser particles, and other means would require to be adopted to remove that foulness, which the filtering beds must necessarily contract in the course of time.

THE SPEED-CLOCK.

Sir,—Not having seen the speed-clock noticed in any mechanical work, you will perhaps indulge me by inserting in your valuable Magazine the following lines:

As I have not the satisfaction to know who was the inventor of the speed-clock, I can only say with certainty, that it has been used by the spinners in the West Riding of Yorkshire upwards of twenty years; and I have thought it odd that Donkin's Tychometer should have been so frequently mentioned, whilst the services of its more valuable cotemporary have been passed over in silence.

This little machine is constructed by the clock-maker, and may be connected with any part of the works as circumstances admit; but it is generally either propelled from the top of the governor-shaft in the engine-house, or from the lowest convenient speed inside the mill. It consists of a number of wheels and pinions, so calculated, that when the machinery is running at the most eligible speed, its three hands, which indicate on a dial-plate, hours, minutes, and seconds, correspond and keep time with those of a regular time-keeper, which is always going by its side; so that by comparing these two instruments together it may be easily ascertained at any time of the day what length of thread has been delivered by the front-rollers, or, in other words, what portion of the day's work may be already completed.

Though the speed-clock, in its present state, is found to be a very useful appendage to a mill, yet it will be seen that it is still capable of being carried to a greater degree of perfection. It not unfrequently happens in the manufacturing districts that a gentleman of capital will build a mill, erect an engine, and afterwards let out the power to different individuals in single rooms at a certain rate the spindle per annum, to run so many hours a day, without any thing whatever being said in the contract about the speed or stoppages of any kind. This sort of agreement is sometimes attended with much uneasiness, and with litigation, ending in ruin.

Now, by introducing into the speed-clock an additional hand to go round once every six months, this cause of uneasiness might be entirely removed, and the speed-clock, like the gas-meter, would then faithfully register every turn of the machinery from one rent-day to another. The parties might specify in their contracts the mean number of revolutions to be gone through each day; and thus secure to themselves a faithful, unbiassed servant, that would not be subject either to the faults or infirmities of human nature.

I remain your's respectfully,

Keighley. GILBERT.

HUMANITY NO GAINER BY THE SAFETY LAMP.

A very curious comparative statement has appeared in the *Morning Post*, of the number of explosions in coal mines, and deaths occasioned by them during the ten years which preceded, and the ten years that succeeded the introduction of the safety-lamp, invented by Sir Humphrey Davy. From this statement (the accuracy of which we see no reason to doubt) it appears there were,

	Explosions.	Deaths.
From 1805 to 1816	9	284
From 1817 to 1828	19	360
Excess since the introduction of the Davy .	10	76

The Editor of the *Morning Post* adds, that he thinks this excess is owing to the *workmen* relying so much on the *Davy, that under its protection* they now work in places where they would not have formerly ventured to take a light. We have no doubt this is nearly the true state of the case, and

that had the same hazards only been encountered to which the pitmen were exposed before the introduction of the lamp, there would have been no such excess, but, on the contrary, a vast diminution in the loss of life. We must beg leave, however, to enter our protest against the blame of this excessive dependence on the Davy being thrown on the shoulders of the poor "*workmen*." It is not the men who work in such places of their own accord, but their rapacious masters, who compel them to work there or starve. In a "Plain Statement of the various Grievances of the Pitmen of the Tyne and Wear," published in 1825, we find one of the principal of these grievances founded on this very circumstance. "When the safety-lamp," say the people of one colliery, "was introduced, proper allowance was made to the workmen for working with it, *and no bad aired place was wrought in;* but when repeated experiments have proved what the lamp will do, the case is altered; now we have no allowance for the lamp, and the *worst and most dangerous places* can be wrought. Places are now at work, where the air is so inflammable, *that the lamp is frequently red hot;* and sometimes it is extinguished, and the danger to the workmen very great in consequence." To the same effect the men of another colliery observe, "Sir Humphrey Davy's invention of the safety-lamp has been an advantage to the coal-owners, but a great injury to the comfort and earnings of the pitmen; for while the former may remain indifferent about the safety of the mine, and neglect to form the proper supply of atmospheric air to the inner parts of the pit on account of the great power of the lamp to resist combustion or explosion, the poor miner has to suffer the most awful agony in an exceedingly high temperature, inimical to his health, comfort, and even life." The manner in which the Davy has been so beneficial to the coal-owners, while it has added to the sufferings of the pitmen, is elsewhere in the same pamphlet explained to be, that besides enabling them to dispense with the old processes of ventilation, it enables them *to work a greater extent of ground* with fewer shafts, and in both ways to save a great deal of expense.

It is truly melancholy to reflect, that an invention which had the saving of life for its sole object, and which, properly used, is so pre-eminently calculated to accomplish that object—which brought so much honour to its author, and has been hailed by all the friends of humanity as one of the most precious discoveries of modern times—should, in the hands of an over-grasping cupidity be thus employed to the destruction of the very individuals whom it was intended to protect and save! No wonder the poor pitmen should ("between hope and despair," as they say) be forced to exclaim—

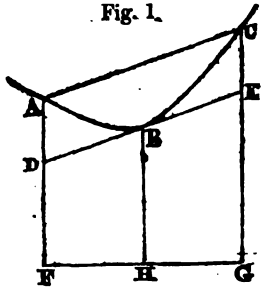
> "Poor men suffer, good men grieve,
> Knaves devise, and fools believe;
> Help, O Lord! send aid unto us,
> Or knaves and fools will quite undo us."

Surely a patriotic Legislature might be worse employed than in interfering between the colliers and their iron-hearted masters. A state of suffering such as is described in the Statement we have before quoted, cannot long exist in any class, without injury to the interests of the whole community.

EQUIDISTANT ORDINATE METHOD—SECOND INVESTIGATION.

[The following is the additional investigation of this method, which we announced in our 316th No. It will be found similar in its first steps to that of OCF, and to differ from it chiefly in its extension of the equidistant ordinate method, to the quadrature of the circle.—EDIT.]

Fig. 1.



Sir—Your correspondent H. T requires an investigation of the rule

for finding the area of a curvilineal space by means of equidistant ordinates.

Let ABC, *fig.* 1, be a parabola; AF, BH, CG, three equidistant diameters, cut at right angles by the straight line FGH; through B draw DE, touching the parabola in B, and meeting FA, GC, in D and E. Join AC, then AC is parallel to DE (prop. 11 Parabola.—Woolwich Course) also the area of the parabola ABC is $\frac{2}{3}$ of the circumscribing parallelogram ADEC, (prop. 16, Course.)

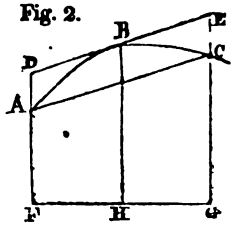
Now the area AG=(AF+CG) FH,

And 2DG=(2DF+2EG) FH=4BH·FH.

But 2 DG+AG=3 AG+2 DC=3 AG+3 ABC. Fig. 1.

=3 ABCGF. ∴(AF+CG) FH+4 BH·FH=(AF+4 BH+CG)·FH=3 ABCGF; hence ABCGF=(AF+4 BH+CG) $\frac{FH}{3}$

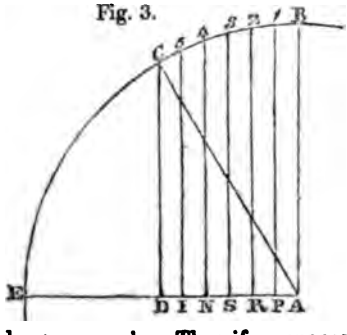
Fig. 2.



In Fig 2nd. 2 DG+AG=3 DG+DC=3 DG+3 ABD+ +3 BEC=3 AFGCBA. ∴as above, the area AFGCBA =(AF+4 BH+CG) $\frac{FH}{3}$

Secondly. To find an approximation to the area of a curvilineal space different from a parabola.

Fig. 3.



Let ABCD, fig. 3, be any curvilineal space. Divide AD into any number of even equal parts by the perpendiculars 1 P, 2 R, &c. meeting the curve in the points 1, 2, 3, &c. Then if we suppose a parabola having its axis parallel to the perpendiculars, it will nearly coincide with a portion of the curve, viz. B12. ∴ By the first proposition,

the space AB 2 R=(AB+4 P 1+R 2) $\frac{AP}{3}$ nearly.

And — R 2, 4 N=(R 2+4 S 3+N 4) $\frac{AP}{3}$

— N 4 CD=(N 4+4 I 5+CD) $\frac{AP}{3}$

∴ABCD=(AB+4 P 1+2 R 2+4 S 3+2 N 4+4 I 5+CD) $\frac{AP}{3}$

nearly. From which may be deduced the following,

Rule.—To the sum of the extreme ordinates, add 4 times the sum of the even ordinates, and twice the sum of the remaining odd ordinates, and the sum multiplied by ⅓ of the common distance will be the area required.

Now, in order to see how near the above rule is to the truth: suppose AB 4 D tobe a portion of a quadrantof a circle and that AD=D 4; join AC; then it is manifest that ABC is ⅓ of the quadrant ABC, or $\frac{1}{12}$ of the whole circle. Also suppose AD to be divided into ten equal parts, and that AD=10; then the ordinates AB. P 1, &c.

will be 20, √399, √396, √391, √384, √375. √364, √351, √306, √319, √300; hence 20+√300=

37·3205081

(√399+√391+√375+√351+√319) 4=382·8367444
√396+√384+√364+√336) 2=153·8095068

3) 573·9667593

area of the space ABCD, 191·3222531

From which the area of the circle may be found. For the triangle ADC= 5√300=86·6025405 ∴ 191·3222531—86·6025405=104·7197126 area of the sector ABC; hence $\frac{104·7197126+12}{40^2}$=·785397844=area of a circle, whose diameter is 1. Now the area of a circle whose diameter is 1, is known to be ·785398163. If great accuracy is not required, fewer ordinates will answer the purpose. Thus, suppose, AD had been only bisected, the area computed by the above rule will be 191·3003, a near approximation to the space ABCD.

I am, Sir, Your's, &c.
G. S.

PERPETUAL MOTION.

[The following is an extract from the letter of an esteemed Correspondent, to whom our readers have been indebted for many valuable contributions to our pages.]

"I now send you a copy of a memorandum I have placed among a great number of papers, diagrams, notes, &c., on the subject of perpetual motion, but all unintelligible to any one but myself. 'Infatuation all,' you will say; but though I might not be able to deny this charge *in toto*, yet this I will say, I can demonstrate the possibility of perpetual motion by the action of material bodies on one another, aided by the constantly existing powers of nature, made available to that purpose. The memorandum is as follows:—

"Query—What ought to be the reward for the invention of a continual self-acting power which may be increased at pleasure and without limitation, excepting that of the strength of materials acted upon by their own weight? That this is possible and practicable I am now convinced, and that there is no law of nature or even theorem *in the science of mechanics* which goes to controvert the assertion. But the principles on which it may be effected, and particularly the practical means, have hitherto eluded the researches of the ingenious of all ages to the present hour, and now lie concealed in the breast of an individual who may possibly, from neglect and want of encouragement, be induced to relinquish a pursuit the developement of which would confer an incalculable benefit on mankind, and the loss of which may require ages yet to come to recover.

"That the above is the unequivocal and sincere opinion of the writer is attested by his own hand this 25th of February, 1829.

* * * * * * *

(*From the Philadelphia Gazette.*)

"We were much gratified yesterday, with the result of an examination of a self-moving machine, which may be seen at Bowlsby's Merchants' Hotel, in Slater-street, and which the inventor calls a Perpetual Motion. We have no doubt of its being nearer a perpetual self-moving principle than any invention that has preceded it, and as near as any we shall ever see. The great merit, aside from its practical uses, is its sim-

plicity, and the certainty and readiness with which you perceive that it covers no trick or deception. It is little less than an illustration of one of the most obvious laws of nature. The agent is the atmosphere, bearing directly, by means of perpendicular boxes and oblique tubes, upon the buckets of a wheel, which is propelled with greater or less velocity, but which is constantly propelled, and will continue to run, without the possibility of cessation, while the materials of which it is composed last, and the present laws of nature continue. The inventor is Mr. Richard Van Dyke, of Orleans county, in this State, who gives it as the result of five or six years' application to the subject. He is a venerable man, communicative and intelligent, and described as highly respectable by several citizens of the West, on whose representations entire reliance may be placed. He affects no mystery, but clearly and satisfactorily explains the arcana of the machine."

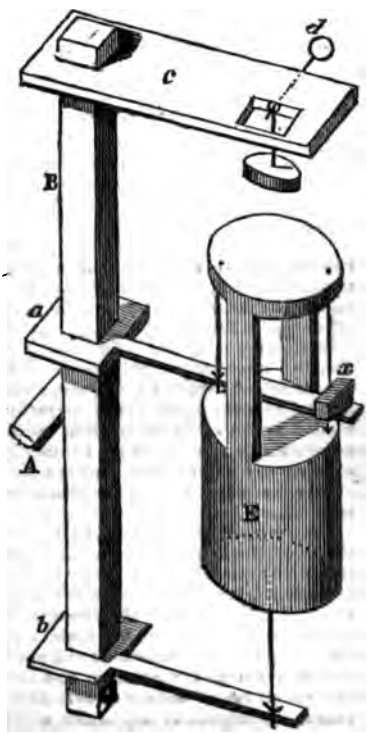
A GIGANTIC STEAM-BOAT.

The Dutch have been engaged for the last five years in constructing and equipping a steam-boat of extraordinary magnitude, in order to facilitate the communication between Holland and Batavia. It has four masts, is about 250 feet long, has cost upwards of 100,000*l*., and has been appropriately christened the MONSTER. In consequence of her great length, she hung when going off the slips, and it was some days before she was fairly launched; a circumstance which gave the wits of Paris occasion to remark that their Dutch neighbours were so determined to excel all other nations in the magnitude of their steam-boats, that they had built one *so long*, that it was several days running off the stocks; a wonder only to be matched by the story of the giant who had so magnificent a stride, that it took three days to sail between his knees. One of the most remarkable features of this enormous vessel is, her extreme narrowness as compared with her length; her greatest breadth of beam being only about 32 feet. Although it is now four years since she was launched, it was not till within the present month that she was ready for sea. *On the 7th inst.* she descended the Maas, with the intention of making a trial of her powers in the German ocean, before proceeding to the East Indies, and it is not improbable, therefore, that she may favour the Thames with a visit.

The great size of this vessel will bring to the recollection of our readers the Columbus, which was built in the river St. Lawrence, in 1824, and made the passage to England in safety, but was afterwards broken up on account of her unmanageable bulk. We shall not be surprised to find that a similar fate awaits the Monster, and for a similar reason. The Columbus was larger than this Dutch rival, by some fifty feet in length, and eighteen in breadth; but not so much so as to constitute any material difference between them.

MOMENTUM OF FALLING BODIES.

(Continued from p. 423, vol. xi.)



—I must request your readers me the favour to substitute the *ttraction* for *pressure* in the rst line from the top, page 424,

apparatus consisted of a piece d, a part of which is shewn at ; enough to rest on the top of a hich was fixed perpendicularly, of square wood B, on which the *a* and *b* were fixed by wedges; o the piece of wood *c*, for hang- weights to. The weights were turned true, and suspended by d from the centre. They hung wire *d*, which, on being with- let them drop without shaking E is a cylindrical piece of a portion of which is cut away pper part to allow the guide ss through it; E is kept up- y two pieces of wire working guide *a*, and one piece working guide *b*. A small piece of cork, *s*, put on to one of the wires so as to slip easily upon it, completes the whole; this was for the purpose of measuring the distance to which the fall of the weight sunk E; the cork being placed as shewn in the drawing was stopped by the guide *a*, when E moved down, therefore, the wire passed through the cork; which, sticking to it, shewed the greatest depression of E.

It is to be observed that it was not requisite to ascertain the *exact* depression of E, as the experiments were only intended to prove the error of a conclusion already formed; and not to constitute the basis of a theory.

The tub was filled with water and the height at which E stood marked; ten ounces were then laid on the top of E which sunk it five inches and three-eighths deeper. A weight of five ounces was then suspended so that the bottom of it was six inches and three-eighths clear of the top of E.

Table of Experiments.

5 ounces fell	6¾ and sunk E	5⅜	The weights rebounded, and sometimes flew off. After this they settled more steadily.
	4¾	5⅜	
	4¼	5⅜	
	3¾	5½	
	2¾	6¼	
	2 1/16	5 1/16	
	1¾	5	
	1	4¾	Full.
	¾	4¾	
	½	4¾	
	¼	4¾	
	⅛	4¾	
	1/16	4¾	

xperiments were repeated with , a two, and a one ounce When either of them fell es and three-eighths, it sunk nder E to the same depth as t. weight *laid* upon E sunk it, o deeper; but they settled upon E. When either of eights were allowed to fall and a quarter inch, they sunk nder E to the same depth, bout an eighth of an inch as ey fell six inches and three-

if we estimate the force of a body from these experiments, of them shall we take from to calculate that force? The nly one-sixteenth of an inch equal claim with the fall of *s until three-eighths*, and yet, what widely different results they will give. But the fact is, that of all the methods that have been imagined, to measure percussive force by experiment, those depending on the depression of a floating body by the fall of another body upon it, are the *very worst*, and it is a pity that *scientific* men should be so unthinking as to lead *practical* men to place any dependance upon them. Carelessness of this kind only serves to increase the contempt which one class feels for the other, a feeling which every one must deplore who is solicitous for the improvement of the arts.

But the error may be shewn in a readier way. A body before it has fallen *one inch* acquires a velocity of twenty-seven inches per second. The force of such a body is equal to that

of a body nine times its weight moving at the rate of three inches per second. And the force of a body in motion, although that motion be ever so slow, is greater than the force of its dead weight, which is easily proved either by reasoning or experiment.

In the same simple, cheap, and easy manner might the principles be put to the test upon which all those new inventions and new schemes depend, for which we see patents daily obtained, and money daily wasted; for in too many cases they turn out completely useless and unprofitable.

As some of your correspodents may perhaps amuse themselves by explaining why the five ounce weight with a fall of one sixteenth of an inch sunk the body E seventy-eight sixteenths of an inch, while the fall of one hundred and two, only sunk the same body eighty-six, I shall not at present attempt to account for it.

I am, Sir,
Your's respectfully,
S. Y., A Young Engineer.

Aug. 26, 1829.

P. S.—I know nothing whatever of the description of an engine to which Mr. Jarvis alludes, said to be signed S. Y.

THE NEW FLEET MARKET.

Sir,—I trust to your sense of justice for the prompt insertion of a few remarks in vindication of the New Fleet Market from the strictures of the writer of the Rough (*coarse* would have been the more appropriate word) Notes in your last Number.

The chief fault your Correspondent finds with the market is, that the principal entrance was not made at the bottom instead of the side of the inclined plane. But he has wilfully overlooked the fact, that the greater part of the bottom of the plane in question is occupied by houses fronting the Old Fleet Market, the purchase of which would have added immensely and unnecessarily to the expense the Corporation have been at to obtain a clear space for the market. Was the architect to blame for this?

Another fault he finds is, that the shops on two sides do not look into the square of the market. But suppose it should turn out that orders were given to study the *security* of the occupants of *the shops, in preference to* any thing else? Would the architect be to blame in this instance more than the other?

The shops have no openings *externally* (the gratings at the top excepted) either on the side of the market square, or on any other side; they consist of double ranges, with open fronts facing each other, but blocked up behind; and the access is by gates at different parts, the closing of which at night will effectually exclude those crowds of thieves and vagrants, who were wont to make Fleet Market their nightly rendezvous.

The clock-tower does not please your Note-taker: but *chacun à son gout; he* does not like it; *I* do. Who is to decide?

The key-stone of the gateway fronting the Old Fleet Market is said to obtrude itself to no purpose (something like the Rough Note-taker's remarks.) Now, so far is this from being true, that fifty instances from this very metropolis might be adduced of key-stones obtruding in the same way. To go no farther, Sir, than your own neighbourhood, I need only refer to Temple Bar, (a work of Sir Christopher Wren's) where an ornamental curved key-stone may be seen projecting quite as much as this of the New Fleet Market, and supporting just as little.

I am, Sir,
Your obedient servant,

Sept. 13, 1829. CIVIS.

[Having referred the preceding letter to the author of the Rough Notes, he has favoured us with the following reply.—ED. M. M.]

" This by his voice should be a *Montague*.
Fetch me my rapier, boy."—SHAKSPEARE.

Dear Sir,—I am obliged to you for your early communication to me of *Civis's* letter. Publish it by all means, but have the goodness, when you do so, to publish at the same time this my reply:—

I confess, I *did* overlook (though not "wilfully") the fact, that the greater part of the bottom of the plane in question is occupied by still unpurchased buildings. Of course, we must transfer to the Corporation the blame which we have imputed to their travelled architect, for not making the entrance to the market where it ought to have been. But since the architect could not have an entrance at the bottom of the plane, why did he not get rid of the plane altogether? It would have cost but the expense of removing so many more cart-loads of rubbish to reduce the ground to one level, and of one level it ought unquestionably to have been.

The idea of blocking up the shops for "security" sake, is one which certainly did not occur to me. Deplorable as we all know the state of the police of the metropolis to be, one could hardly have imagined that it had reached to such a pitch, that people must be *built in* to secure them effectually from depredation!

"*Chacun à son gout.*" Doubtless! But every one's taste is not a pure taste. There is a classical taste, and a barbarous taste; a Grecian taste and a Wapping Old Stairs or Low Dutch taste. *Civis* asks, "Who is to decide?" He ought rather to have asked, "Who is there to approve?" The very drovers laugh at the new clock-tower as they pass, and insist that it is not half so fine (which is the truth) as the clock turret of the Old Market.

Civis affirms that "fifty instances from this very metropolis might be adduced of key-stones obtruding in the same way," as the one in the gateway of this market. I defy him to produce *one* from any building of authority in matters of this sort. His reference to Temple Bar is singularly unfortunate. It is true, that on the side of this gateway next the city, there is a key-stone of a scroll-shape, which at the present time supports nothing; but had *Civis* examined the edifice a little more closely, and compared the inside with the outside of the gate, he would have discovered, that it originally supported an armorial shield, which has in the course of time fallen down.

I remain, dear Sir,
Your's, &c.
The Author of the "Rough Notes."

Sept. 14, 1829.

JACKSON'S PATENT STUDS.

"If the Patent Stud-Maker would screw in that part of his stud that he intends to force into the leather, he would certainly improve his invention; for if one of the studs which he describes in your Number, were to come out, it would make a complete thoroughfare to the foot. I have tried a common screw many a time, and it answers the purpose very well; if the materials would last it would never come out."—*Extract from the Letter of a Correspondent.*

Our correspondent seems to have overlooked, not only that screws would cost a great deal more, but that it would require ten times the labour to insert them. *The stud is meant* to effect the same purpose as a screw in an easier way; and, for our own parts, we have no doubt of its retaining its hold equally well. We are glad to learn, that since the appearance of our notice on the subject, orders have been given at the Horse Guards for a trial being made of the stud, preparatory to its general introduction into the army. —EDIT.

ORGAN FOR THREE PERFORMERS.

Messrs. Flight and Robson, the builders of the celebrated Apollonicon, have just completed for Sir R. Vivian, an organ of a very novel and much-improved construction. While most organs have one, two, or, at the most, three sets of keys, this has no less than five; three in front, one above the other, and one on each side; so that three performers may play on the instrument at the same time, and all in perfect unison. The mechanism, on which the *swell* depends —the most difficult part by far of organ building—has here been so skilfully contrived, as to give the players a perfect mastery of the gradations of tone, free from any of those sudden bursts which are so commonly characteristic of inferior instruments. The pedals are of the compound description, invented by Mr. Flight, and described in our 238th Number, p. 101; an invention, by the bye, which we have lately seen very unfairly ascribed to the Germans. A first trial of this organ was made last week by Mr. Adams in the presence of a select party of competent judges, when it appeared to give the most unqualified satisfaction. D.

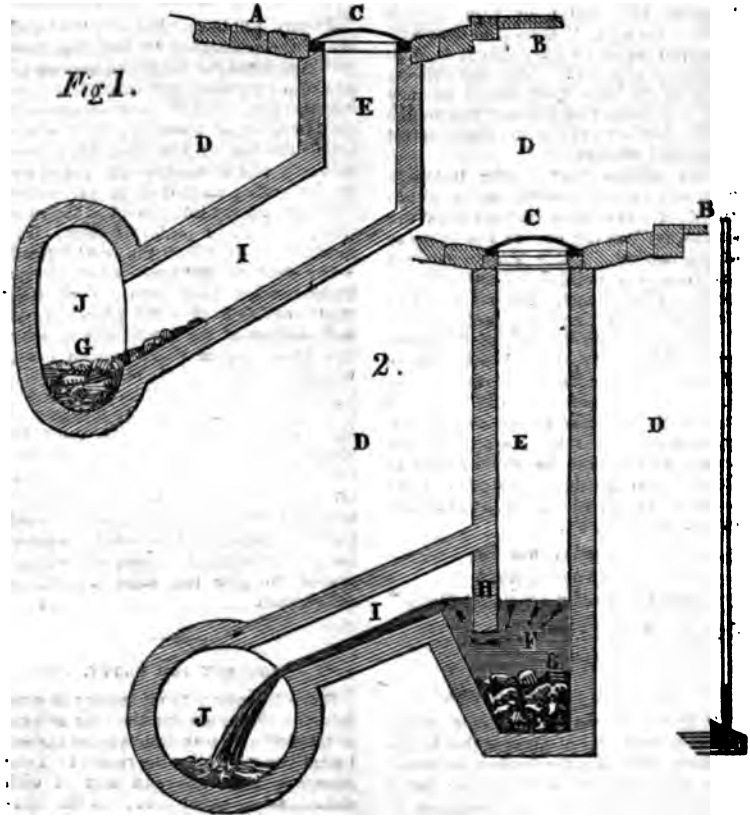
SOLVENT FOR PUTTY.

Sir,—In answer to an inquiry in your valuable Magazine for the best solvent to take off old putty from glazed sashes, I send you the following recipe:—Take American pearl-ash and mix it with slaked stone-burnt lime, to the consistency of paint, and apply the same until you find the strength of the putty is drawn out. The greatest difficulty is to get it to enter the bedding putty, which must be done over with the solvent oftener than any other part. The same solvent will prevent the necessity of burning off paint, as if applied with a brush over the whole surface, it soon destroys the tenacity of the paint.

Your's, &c.
PETRUS.

IMPORTANT IMPROVEMENT IN THE CONSTRUCTION OF PUBLIC SEWERS.

A new mode of constructing sewers has been adopted in the course of the recent improvements in St. James's-park, which appears to us to possess several important advantages. It was suggested, we understand, by a Mr. Cuff, of Ebenezer-terrace, London Hospital, who had previously succeeded in introducing it into several places in his own neighbourhood—as Whitechapel, High-street, (north side) Leman-street, Goodman's-fields, &c. To enable our readers to understand in what the merit of this new plan consists, we must first describe to them the manner in which sewers have been hitherto usually constructed. The following engraving, fig. 1, represents a section of a common sewer.



A is the paved roadway, B the foot pavement, C a grating covering the mouth of the well or sewer EI, J the main sewer, DD the solid earth.

The natural consequence of this mode of construction is, that all the more ponderous matters which descend the branch sewer EI, deposit themselves at the point of junction with the main sewer J, (as represented by G,) *where they continue to* accumulate, till at length the entrance to the main sewer is entirely choked up and a bursting or blowing up as it is called of the masonry, takes place. While this accumulation too is going on, the filthy mass is constantly giving forth the most noxious vapours; particularly after every fall of rain, and wherever there is a distillery, a brewhouse, a dyeing house, a slaughter house, or any similar establishment to

contribute its daily floods of hot liquid refuse to assist the process of exhalation. And after the blowing up has taken place, then commences the very pleasant and convenient process of stopping up the street, breaking up the pavement, clearing and repairing the sewers, remaking and repairing the ground, &c. When all is done, the cause of the first choking up of the sewer still remains unobviated, so that a year or two seldom elapses before another stoppage takes place, and the same tedious round of operations has to be gone through again. The insalubrity which these depositaries of filth impart to the atmosphere, and the trouble and inconvenience attending the accumulation and removal of them, are not the only evils of which the public have to complain. The money laid out annually in the repair of the public sewers is *enormous;* arising almost solely from this very injudicious mode of constructing them.

The new method of construction which Mr. Cuff has introduced, is represented by the sectional view, fig. 2.

A is the paved roadway, B the foot pavement, C the grating, DD the solid earth, EG the well, I a branch sewer, leading into the main sewer J.

The advantages of this mode of construction will be at once perceived. In the first place, all the ponderous matters fall to the bottom of the well EG, and are detained there out of the way of the discharging sewers, till they are removed, (which it is proposed to do once a month) by the rake, fig. 3. Secondly, this deposit is always covered with water to a sufficient depth to prevent its giving forth any noxious odours, precisely as the "stink trap" commonly used in the sinks and drains of private houses, protects them from the like nuisance. Thirdly, the supernatant water as often as it rises to the level of the branch sewer I, passes off into the main sewer J, and is thus in a state of constant change. Fourthly, it is water only, though doubtless water in a state of great impurity which is conveyed through the main sewer into the Thames; so that were all the sewers constructed on *this plan, there would not be a* tenth part so much filth discharged into the river as heretofore, and the objections which have, on account of that filth, been made to the river water as a source of supply for domestic purposes would be almost entirely obviated.

We make no doubt whatever that an improvement of such great and manifest utility as this, which is, withal, extremely simple, and cannot be expensive, will be forthwith universally adopted; not in the metropolis alone, but in every well regulated city and town, to which a knowledge of it may extend.

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS.

(Continued from p. 28.)

If a single force act on a body, it must move in the direction of, and in proportion to that force. For if it move quicker, it must possess some moving power of itself, and, consequently, cannot be inert; which is impossible. The same may be said if it moves slower.

In speaking of velocity there are two things to be attended to, viz. time and space. A mail-coach may travel on a road, and so may a waggon; they may travel over the same space, but yet not with the same velocity, because the time is not stated. Again, the coach may run for six hours as well as the waggon, although the velocity may not be the same, as the space gone over is not given.

But when the time and space are both given, then the velocity may be known by the product of these two. It would be impossible to multiply the mere idea of time by that of space, therefore a certain standard is fixed for them; thus a second is the unit of time, and the foot is that of space, and the velocity means the number of feet passed over in a second, or the unit of time.

In the last case only one force has been supposed to act; now suppose there are several.

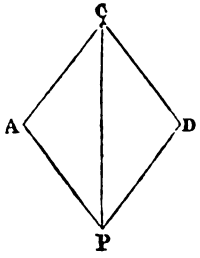
In the first place, suppose they all act in the same direction and the same straight line. The effect is here found by adding the amounts of the

different forces, and which will be equivalent to the given forces.

The next case is when there are two forces acting in the same straight line, but in opposite directions. Were they equal, they would keep the body on which they acted in equilibrium; but if one have a greater velocity than the other, their difference will be the effect produced, and which will be exerted in the direction of that which has the greater velocity. Thus, if A moves with a velocity of 10, and B only with that of 8, then the body will be projected with a velocity of (10—8=)2, and in the direction of AB.

The next proposition is when there are several forces acting upon a body, but all in the same straight line, though not in the same direction, to find the effect. The sum of all forces acting in one direction must be subtracted from that of the opposite forces, the difference will be the effect produced.

What is said of motion may also be applied to pressure, excepting that the latter does not produce motion.



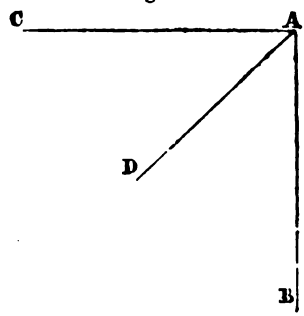
If the forces act neither in the same direction nor in the same straight line, the foregoing rules will not hold good. Suppose there are two forces, A and D, acting on a body P in the different directions AP and DP, it is required to know what single force will produce the same effect on the body P. Let the line AP bear the same proportion to the force A as DP does to D; thus let it contain as many inches as the force has pounds, &c., then draw the lines AC, DC, parallel to DP, AP, and the diagonal CP of the parallelogram ACDP will be in the same proportion to, and in the *same direction as the force* required. This figure is called the parallelogram of forces. This rule is not confined to pressure, but will also apply to motion, for the body P would move along the diagonal PC in the same space of time when moved by the two forces A and D together, as it would move along either line PA or PD, when impelled by either of the forces singly.

A proposition exactly converse to the composition is the resolution of forces, viz. if one force be given to find what two forces are mechanically equivalent to that force. It is very easy to a person acquainted with the former, to find an answer to the present proposition. It is only to describe a parallelogram on the force taken as a diagonal, and the two sides will be the required forces.

The composition differs from the resolution of forces, inasmuch as the former is a determined and the latter an undetermined problem; for in the former case; the single force is the only one into which the two given forces can be compounded, whereas there are several pairs into which a single force may be compounded.

These two problems are very essential, as the whole doctrine of mechanical powers consists in nothing but the composition and resolution of forces; for any weight to be suspended by a crane or other machine is resolved into two weights, whereof one is thrown upon the fulcrum of the machine, while the other is balanced by the power.

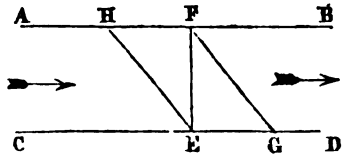
Fig. 3.



There are several familiar instances by which these problems may be illustrated. Suppose a ship A (fig. 3.) were in a current running in the direction AC, and that the wind were blow-

ing in the direction AB, and would impel the ship with the same velocity as the current would were they acting singly, it would neither move along AC nor AB, but along the diagonal AD. Again, suppose a person wished to row a boat across a river (which has a current) so as to arrive at a point exactly opposite to that from which he sets out.

Fig. 4.

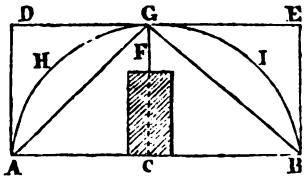


Let the two parallel lines AB and CD (fig. 4.) represent the sides of a river, the current of which runs in the direction of the arrows, and that E is the point from which he sets out, and F that he wishes to reach. Now, it is evident that were he to row exactly across he would be carried a considerable way down the stream by the force of the current. Therefore he must row to a point higher up the river, and it is required to find that point. Now, let EG be the distance the boat would float down, were it carried along by the current alone, in the time that the man could row his boat across the same river were there no current. Then, from F draw FH in the direction FA equal to GE, and draw the lines HE and FG, which will be parallel. Consequently, the figure HEGF is a parallelogram, and as the boat would move when impelled by one force (the current) along the side EG in the same time it would be moved by the other (the oars) along the other side EH, it will when impelled by them both together move, in the direction of the diagonal EF, and would arrive at the point F required.

Every one knows the effect produced by leaping from a carriage during its progress. There are two forces to be here compounded, viz. that produced by the velocity of the carriage, and that by the muscular effort exerted on the occasion; consequently, *instead of alighting on* the ground at the point required, the person making the leap would reach the ground at a place considerably advanced.

Most persons may have seen the equestrian feat of leaping through a hoop or over a bar, &c., and alighting on the back of the horse again; this is effected by means of this property of inertia.

Fig. 5.



Let AB (fig. 5.) be the line on which the horse is supposed to run, and CF the board or obstacle to be leapt over by the rider. In order to alight on the horse again, he must not leap forward, but only upwards, and must so measure his effort that he may ascend from A to D and back again in the time that the horse would take to run from A to B; consequently, he would arrive at D in the same time that the horse would reach C; thus his muscular effort may be represented by the line AD, while his velocity (retained by his inertia) may be shewn by AC, and these two forces when combined would move him in the direction AG, and he would reach G at the same time that the horse would be at C. By saying he would move along the diagonal AG, his upward motion is considered as uniform, but it is not so, for it is quickest at first, and gradually becomes slower till he reaches as high as D, when he would descend; therefore the force AD being at first stronger than that of AC, he will ascend along the curved line AHG. But he is now at G while the horse is at C. Now he has not lost his velocity yet, but keeps it acting in the line GE, while his gravity acts in the direction GC, consequently, he will descend along the diagonal GB of the parallelogram GEBC, or rather for the same reason as given before, along the curve GIB, and will arrive again on the horse's back at B.

(To be continued.)

OXALIC ACID NOT ALWAYS POISONOUS.

It is not generally known, we believe, that oxalic acid is only poisonous when taken in a considerable quantity. It may be, and is, taken in smaller quantities, not only without deleterious effects, but the contrary. In France it is used very commonly in the proportion of from ten to twenty drops, or more, of the saturated solution, to half a pint of water, and, in such quantities, is refreshing and slightly diuretic. It is often used, also, instead of the citric and tartaric acids for making punch, and we believe in such cases it is equally innocent and pleasant. It ought to be known, that it requires at least half an ounce or more to produce serious or fatal effects. Nobody need be poisoned by mistaking it for Epsom salts, if, before taking the dose, a single drop of the solution be tasted, the oxalic acid being extremely sour—the Epsom salts not at all. Or if a drop of the solution is put upon black leather, or cloth, or into a little ink, it will, if it is oxalic acid, change the black colour to reddish brown; if it is Epsom salts the black colour will remain unchanged. The reason of this is, that black colours being more or less formed by an oxide of iron, the oxalic acid seizes upon the iron and forms an oxalate which is reddish brown. It is on the same principle that it cleans boot-tops, with the iron on which it unites and effaces the black stains arising from its oxidation in the leather by the agency of the gallic acid, or of the tannin used in the process of preparing it.

Z.

THE 'LIFE' IN AN OYSTER.

The liquor of the oyster contains incredible multitudes of small embryo, covered with little shells, perfectly transparent, swimming nimbly about. One hundred and twenty of these in a row would extend one inch. Besides these young oysters, the liquor contains a great variety of animalculæ, five hundred times less in size, which emit a phosphoric light. The list of inhabitants, however, does not conclude here, for besides these last mentioned, there are three distinct species of worms, called the oyster-worm half an inch long, found in oysters which shine in the dark like glow-worms. The sea-star, cockles, and muscles are the great *enemies* of the oyster. The first gets *within the shell when* they gape and sucks them out. While the ti flowing, oysters lie with the h side downwards, but when it ebbs, turn on the other side.

INQUIRY.

Sir,—What is the reason tha under side of the cornice, and projecting mouldings of stone buil decay rapidly, while the parts exposed remain unaltered by weather? I am, Sir, &c

NEW PATENTS.

George Straker, of South Shields, for provement in ships' windlasses. 28 July. cification to be enrolled in two months.

Louis Quetin, of Great Winchester London, for a new vehicle for the carr passengers and goods. 25th of July. 6

F. H. N. Drake, Esq., of Colyton Devon, for improvements in tiles for 25th of July. 6 months.

John Nicholls, of Pershall, Stafford, tain improvements in the lever and the cation of its power. 25th July. 2 month

Joshua Bates, of Bishopsgate-street London, for a new process of whitening 1st of August. 6 months.

The same, for an improved method structing steam boilers. 1st of Augt months.

John Hutchinson of Liverpool, for in ments in machinery for spinning cotto 30th of July. 6 months.

Nathaniel Jocelyn, of New Haven, America, for improvements in the manu of blank forms for bankers' checks, &c., vent forgery. 3rd of August. 4 month

Thomas Bailey, of Leicester, for in ments in lace-making machinery. 5th of 6 months.

Thomas Brown, of Birmingham, for proved coach. 5th of August. 6 month

INTERIM NOTICES.

In conformity with the plan announ the Postscript to the Preface to our last we shall next week publish a Double which will enable us to give insertion than we could otherwise do, to a numbe portant communications; among others Portable Trigonometry of P. M. W. w announced two weeks ago as being worth of gold to practical men.

The patent, a copy of which "A M turer" has sent us for our opinion, is, majority of patents, so technically de that it would not bear legal investigation

The conclusion of the paper, On the U Vitality of Matter, we are obliged, for room, to postpone till next week.

Communications received from J. O.—D——1. H. B.—T.—Cosine—A Naviga R. A.—Divisor—Mr. Renshaw—A C Reader—Galena.

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M. SALMON, Printer, Fleet Stree

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 320.] SATURDAY, SEPTEMBER 26, 1829. [Price 6d.

MACHINE FOR DRAWING ELLIPSES AND SPIRALS.

Fig. 1.

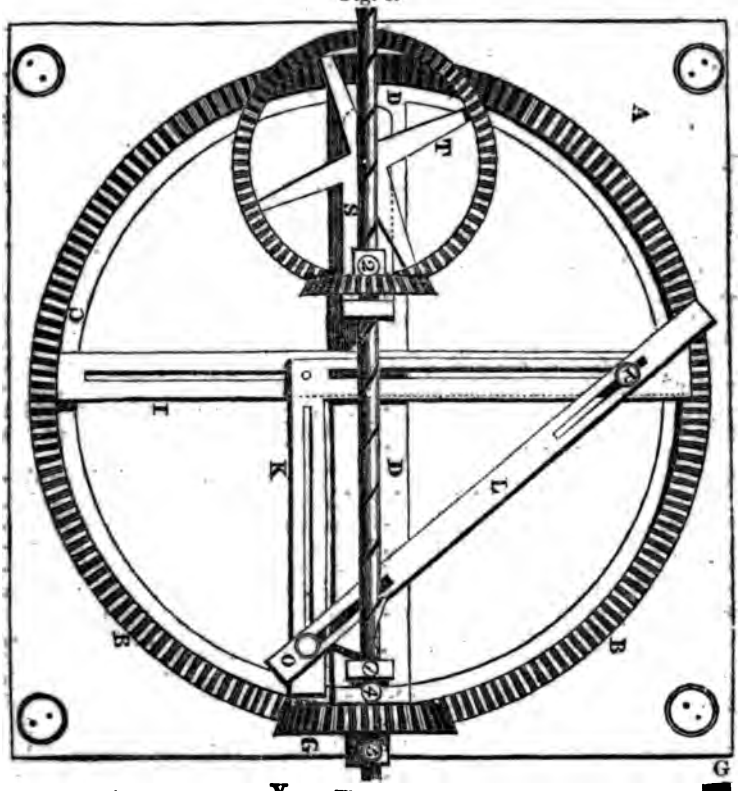
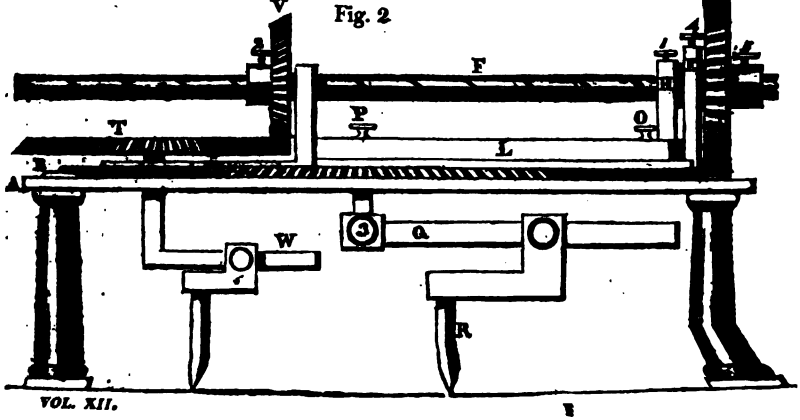


Fig. 2



MACHINE FOR DRAWING ELLIPSES AND SPIRALS.

Sir,—Having apprized you that I had invented a machine for drawing spirals by continuous motion, I now do myself the pleasure to enclose you a rough sketch of the same, and shall be happy to see it inserted in your work, should you think it would be interesting to your readers.

The following is a description of the machine:—

Fig. 1. is the plan,

Fig. 2. is the elevation; the same letters are used in both figures.

A. A square frame supported on four short pillars.

B. A bevelled ring with teeth, attached to A.

C. A ring turning upon a ledge on the inner circumference of B, and having a cross-bar D, with a slit throughout its length.

E. An upright at one end of D, forming a bearing for the horizontal axis F, on which axis a screw of one thread is cut.

G. A bevelled pinion on F, and working into the ring B.

H. A nut upon F, which is made to advance along F during the revolution of F, by means of a pin 1, taking into the thread of F, its lower end being let into the slit in the cross-bar D; but if the pin 1 is withdrawn, H remains stationary.

I. A bar with a slit in the direction of its length, which is attached to the ring C at right angles to the bar D, when the instrument is required for circular spirals, but removed when the instrument is used for drawing ellipses.

K. A bar in the shape of the letter L, having a slit in each leg, and attached to I by pins, which allow it to slide in the direction of the slit in I.

L. A bar upon K, and capable of being set to any angle by means of the tightning screws OP, which slide in the grooves in K and L.

Q. A bar turning upon a centre, (to which it may be set at any angle by the screw 3) attached to the screw P, but below the frame of the instrument, and carrying the tracer R, which can be set at any part of the bar.

S. A frame sliding along the slit in D, and carrying the bevelled wheel T, and an upright, through which the axis F passes.

V. A pinion, half the diameter of T, and working into it; it can be fixed at any part of F by sliding the frame S along D, and tightening the screw 2.

W. A bar attached at right angles to the axis of T, and carrying a movable tracer.

The instrument will describe ellipses, elliptical spirals, and circular spirals, and, by a slight addition, interior and exterior epicycloids.

To describe an ellipse, remove the bars I, K, and L, and sliding the frame S along so as to give T the required eccentricity, tighten the screw 2, and withdraw the pin 1; then roll the pinion G upon the ring B, and the revolution of the axis F will cause the wheel T to turn twice upon its axis whilst it describes one revolution round the centre of B; by which means the tracer on W will describe an ellipse, the proportions of which will depend upon its position on the bar.

To describe an elliptical spiral.—It should have been mentioned before, that the pinion G has a boss in front turning in the upright E, and prevented from sliding by the pin 4 passing through E, and taking into a groove in the boss; there is also a boss on the back of G, having a pin 5, which takes into a longitudinal groove upon the prolonged part of the axis F; therefore, to describe an elliptical spiral, first set the wheel at the least eccentricity of the intended spiral, and bring the nut H up to the frame S, and secure it there by a tightening screw below the bar D, (not shewn.) Set the screw 1 to take into the thread on F, the screw 4 to take into the boss on G, and slack the screw, pin 5, but so as not to withdraw it from the groove; then upon turning the pinion G the wheel will revolve as before, but at the same time the axis F will advance along the bar D, and will consequently carry forward the pinion V, and wheel T, and thus continually vary the eccentricity.

To describe circular spirals, bring the nut H close to the upright F, the screw 1, taking into the thread on F, and the screw beneath being slack;

also slacken the screw 2, so that the axis F may turn; while turning the pinion V replace the bars I and K, and set L at any angle, say 45°; then upon turning the pinion G, the nut will advance along the groove in D, and pressing against the oblique bar L, will cause K to pass over an equal space along the groove in I, and if the tracer on Q is set so as to coincide with any part of the diameter I, it will describe a spiral of equal distances; but if the tracer be set so as not to coincide with I—as for instance, if it be set any where along the line K—the distance between each turn of the spiral will vary. The number of spirals will be as the number of threads on the axis F, in the space between the nut H and the bar I, divided by the number of revolutions the pinion G makes in passing once over the periphery of the ring B; but should a greater number of spirals be required, then to shift the nut H back again to E, and the bar K to its original situation, slide the tracer on Q to the point where the spiral terminated, and a second and third set of spirals may be drawn, all observing the same law of curvature. The distance between the spirals will be less as the angle of L with K is less.

The invention (such as it is) is entirely my own, with the exception of the method of describing ellipses, for which I am partly indebted to Mr. Child; and also, in some measure, to Mr. Jopling, who has shewn the principle in his "Three Cases of Harmony," in the Mechanics' Magazine: but I should not be at all surprised to find that I am by no means the original inventor; therefore, should any of your readers be aware of a similar instrument being recorded in any work, I shall feel nowise mortified by their pointing it out to

Your most obedient servant,

J. MURDOCH,
Mech. Draftsman.

4, *Vittoria-place, Mile-End-road,*
August 18, 1829.

EXPERIMENTS IN AEROSTATION.

SIR,—Observing several of your pages occupied by theories on the art of flying, I consider it a suitable moment to offer some remarks which may aid the mental efforts of those who consider that art practicable by man. And in so doing, I shall take occasion to detail the result of experiments highly confirmatory of such opinion.

I was led to entertain the notion of the facility of a man flying as a bird, by noticing the rapid progress of the carrion gull, who with expanded wings can make way against the greatest storm, and may be seen at times to go half a mile without wafting a wing. Now, I would ask how does he gain his way against so strong a current of wind without wafting his wings? We easily comprehend how a bird may win his way against wind, by proportionably strong efforts of its wings: but here is a ponderous floating body without visible efforts, moving on against the strongest current of air at the rate of six miles an hour. On contemplating the subject, I formed the idea that the movement was effected by the descent of the bird on a plane so acutely inclined to the horizon as to render the descent of the bird insensible to the eye of an observer. Struck with this apparent cause, I farther conceived the idea that the common kite of the boys might afford means to elucidate the fact. To this end, I caused a kite to be constructed capable of folding or doubling, by having two shafts in the centre united by hinges, so that by a cross-stick at the back of the kite, I was enabled, by relaxing a string which passed through the centre shaft, to reduce the angle formed by the two wings of the kite to any degree I pleased. To this kite I attached two lines; one to the usual belly-band, as the boys call it; the other was made fast to the lower point of the centre shaft; both lines passed through a small brass ring, which ring was again fastened to a piece of twine one-third the length of the kite, and fastened to its centre. When the kite was elevated by holding the upper line, I perceived I could at any moment cause it to descend by pulling the lower line; thus by alternately pulling one or the other, its elevation or depression was effected

by the alteration of the angle which the kite held to the plane of the horizon; and by altering the halyard of the back-stick or yard, whose extreme ends run through two rings fastened to the points of each wing, I could reduce the surface of the kite conformably to the power of the wind. Now, if a man had a kite of the above description elevated over his head by machinery, enabling him to waft the wings and alter the angle readily to any plane with the horizon, I do not see why he might not by practice fly as a bird; at all events, I think that a balloon would be governed by such an appendage.

Although kites have been a common source of amusement amongst youth for time immemorial, I do not know that any such alteration in the mode of constructing or flying them, as I have mentioned, has ever been introduced.

Thus, Sir, we see from what trivial and every-day subjects we might derive assistance in forwarding science; and doubtless a contemplation of the works of Nature furnishes the best hints for our instruction in the fabrication of machines. Should these observations on the flight of the gull, or the little experiment of the kite, be deemed by you worthy the attention of those who have written on the subject, you will confer a favour on an old subscriber, by giving them insertion in your excellent Magazine.

J. W.

Tullamore, Sept. 8, 1829.

BATH MECHANICS' INSTITUTION.

Sir,—Your known attachment to every thing calculated to improve the morals, and increase the small sum of happiness that falls to the lot of the working classes of this country, has induced me to lay before you an account of an unsuccessful attempt to subvert the principles of the Bath Mechanics' Institution. The insertion of this in your valuable Magazine, I think will act as a warning to those who may wish to make similar attempts on other Mechanics' Institutions; and as an example to shew what *can* be done by a determined and *well-directed opposition.*

In the year 1825, a communication in the *Bath Journal* drew together a great number of the working classes of this city, who at a public meeting, founded the Bath Mechanics' Institution. About fifty persons joined in the first instance; the number very shortly increased to one hundred, between which and two hundred, it has remained ever since; more than two-thirds of the members, on an average, being of the working classes. The present number is about one hundred and twenty, by whose subscriptions, and the liberal aid granted by several enlightened individuals of the city, we have at all times kept out of debt, and collected upwards of a thousand volumes, all of a useful character, a stock of apparatus, natural curiosities, maps, &c. &c.

Into this Institution, like many others, a great deal of lukewarmness crept, and the members became inattentive to the election of their committees, &c., notwithstanding the advice given them in a letter which they received from Mr. Brougham on that subject. In consequence, a party sprung up among us, denominated "The Genteels" by the working classes, because of their dislike to the term mechanic, and of their assuming a superiority over men, as good, and more valuable to society than themselves.

The rooms we at present occupy being thought inconvenient, a negociation was commenced some time ago with our President, for rooms in a new building he intended to erect, and which is now nearly finished. Our President demanded 60 guineas per annum for them; but with our present resources, £25. a year for rent is as much as we can afford to pay. As no positive or binding agreement had been made with the Doctor, at a general meeting, some of the members, whose eyes were open to the danger, cried *off*, for fear of embarrassment. "The Genteels" thought otherwise, and having fixed their hearts on going to the new rooms, they proceeded to carry into execution the following preparatory measures at the last quarterly meeting in July:—The first was a change in name, from "Bath Mechanics' Institution" to "Bath Society of Arts and Sciences." The old name

was thought by "The Genteels" not sufficiently expressive or grand for the new rooms, and it certainly was not for the Institution which it was their secret intention to have established there. And, second, a rise in the annual subscription from ten to fourteen shillings for adults, and from six to eight for minors, to meet the extra demand for rent. Both these measures were calculated to hasten the retirement of the working classes,—the object to be gained by "The Genteels"—especially when it was known to be their intention to increase the annual payment, ere long, to £1. "Not too fast—let it be fourteen shillings first," were the words.

In consequence of a very thin meeting of the members, these destructive measures were carried easily, and "The Genteels" had the insolence to raise an indecent shout of triumph when the decision in favour of the change was announced. These doings, however, completely opened the eyes of the lukewarm; several communications appeared in the *Bath Journal*, pointing out the danger, and calling on the members to exert themselves to rescue the Institution from the gripe of "The Genteels." The efforts of the writers were crowned with success; an efficient opposition was formed, prepared to oppose every thing calculated to deprive the working classes of the benefit to be derived from an Institution founded for their especial use.

The President now called a special meeting, and three other new names for the Institution were proposed, as being more palateable to our saucy stomachs. But the ungrateful dogs were stubborn, and not only rejected all of them, but called another special meeting, August 26th, to reconsider the resolutions passed at the last quarterly meeting. A very numerous assembly of the members took place on this occasion, every one of the obnoxious resolutions was repealed, and "The Genteels" completely defeated; ONE of them only had the spirit to hold up his hand in support of measures, for the success of which, on a former occasion, an indecent shout of *exultation had been raised.*

Our President put a stop to the negociations respecting his rooms, thereby relieving us from all apprehension on that subject. If we had removed to his rooms, nothing but disaster would have followed such a step. The first year's expences could not have been less than £120; our revenue to meet it only about £60. In fact, a complete annihilation of the Institution, as a *Mechanics'* Institution, must have followed; and the valuable library, and other property of the members, would have slipped into the hands of persons, for whom it never was intended, either by the founders, or by those liberal individuals who have contributed to the support of an Institution, established for the purpose of furnishing at a cheap rate to the working classes, the means of instruction and amusement for their leisure hours.

Thus, Mr. Editor, you may perceive we have had a narrow escape from the vortex of gentility, that threatened at one huge gulp to have swallowed a famous library, a good stock of apparatus, sundry fossils, shells, maps, &c. &c., in short, every thing needful to commence laying the foundation of a "Society of Arts and Sciences." I will conclude this long epistle by advising the members of Mechanics' Institutions to look sharp into the MOTIVES of all who wish to change the name of their Institutions. Let them cling fast to the name, and never give way on that point while they have breath to speak or a hand to write with.

I am your's, &c.

JAMES JEFFERY,

A Member of the Bath Mechanics' Institution.

Bath, Sept. 7, 1829.

P. S. The defeated "Genteels," to make up for the mortification they suffer, are resorting to the most unmanly measures of retaliation—such as reporting that the Institution has fallen into the hands of democrats, &c., who intend to make it a political society, thereby thinking to injure us in the estimation of our patrons. All such reports are utterly unfounded. But calumny we must expect: our enemies can wield no other weapon.

MESSRS. COPE AND SHERWIN'S NEW PRINTING-PRESS.

(From a Correspondent.)

The improvements made in the printing-press, since Lord Stanhope introduced his iron one, instead of the cumbrous old wooden press, have been so numerous and important, that one might suppose it had been at length rendered as perfect as possible. Every day, however, continues to produce some new press, newer and better than the one that preceded it. Nor is this to be wondered at, when it is considered that of all engines this is by far the most important—and that the liveliest interest necessarily attaches to every device, which promises in the slightest degree to accelerate its operations, or multiply its power.

Of the *new* presses of the present time, that of Messrs. Cope and Sherwin is not, it is conceived, exceeded by any in efficiency It is neat and elegant in its appearance, peculiarly simple in its construction, and pos*sesses* in perfection the qualities of *working with ease* and accuracy of impression. Its working powers depend upon a combination of levers in their most simple form; the friction consequently is extremely small, and the parts can scarcely be deranged until the materials themselves shall be worked out. Instead of the large weight attached to the Stanhope and some other presses, and of the levers with weights employed for the purpose of lifting the platen and causing a return of the bar-handle, powerful springs are placed under the top of the press, which, while they give security and strength, add much to the beauty of the machine. A mode has been also introduced of adjusting the pull from the lightest required, to the heaviest that need be given, namely, by means of a wedge attached to the small screw fixed to the piston in the front of the press, which entirely obviates the necessity of unscrewing the platten bolts to introduce a thickness of card, tin, &c. between the platten and the piston. The oiling of the press, moreover, which is usually a most unpleasant, troublesome, and tedious job, (requiring in some instances as much as half a day) has

been rendered by Messrs. Cope and Sherwin's mode of construction a very simple operation. Their press can be taken to pieces, oiled, &c., and again made ready for work with the loss of *but a few minutes*. When we add to these various recommendations, the great compactness of this machine, and the small space which it will occupy in an office, or on board ship when packed up for exportation, it can be no exaggeration to affirm, that no press has yet appeared so well calculated to promote, both at home and abroad, the art of printing, and the diffusion of those inestimable benefits, of which types and presses are the parent source.

SILVERING CLOCK DIALS.

SIR,—In a No. of your valuable Magazine I saw an inquiry for the best mode of silvering clock dials, and having tried a plan which has proved successful, I send you an account thereof for insertion at your convenience.

How to make the Silvering.

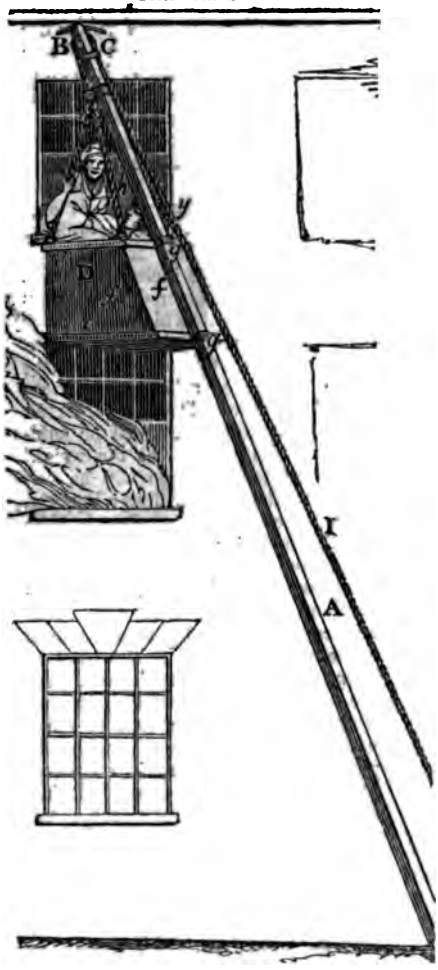
Take of silver or gold lace ½ an oz.; add thereto one ounce of double refined aquafortis. Put them in an earthen pot and place it over a gentle fire till all be dissolved, which will be in about five minutes; then take off the pot and add to the solution a pint of clear water, after which, pour the mixture into another clear vessel, to free it from grit or sediment. Add now a spoonful of salt; the green water will immediately let go the silvering, and the particles will form themselves into a white curd; then pour off the water and throw it away. The white curd must be mixed with two ounces of cream of tartar, half an ounce of whiteing, and a large spoonful of salt, more or less according as you find it for strength. Mix it well together, and it is fit for use.

Directions for use.

Polish your brass with rotten stone and water, afterwards rub it well with salt, and then rub the silvering on.

I am, Sir,
Your's respectfully,
Tiverton. CHARLES DUNSFORD.

FIRE MAST.



Sir,—Some months ago, while reflecting on the various contrivances suggested in the Mechanics' Magazine, for rescuing the inhabitants from houses on fire, I formed the plan of one in my own mind, which was forgotten, in consequence of other engagements, until a few days ago, when I received your 300th Number, containing one, in some respects, similar to my own. But as I still think my own plan better than that of Mr. Gregory's, or any other which I have yet seen described; and as any hint

on so important a subject, when registered in your valuable Magazine, may be converted to some public use —I am induced to send you a sketch and description of it. If it should not be approved, it may suggest some other plan which may be useful.

A, is a mast or pole, of sufficient length to reach over the top of a window, and about the size and strength of the side of a common ladder; or it may be made hollow, of three-quarter deal, to render it lighter and more manageable—say 4 inches square at the bottom, and tapered to about 2 inches at the top. This would be so light that two men might run with it upon their shoulders, and strong enough to convey a heavy man from an attic window. It will be observed that a very light mast will be sufficient for this purpose, as the weight of the car and its cargo will be sustained by the cord on the pulley, and press perpendicularly on the top of it; for the lateral weight on the mast will be only what would be necessary to draw a plumb-line from its perpendicular position to its side. B is a piece of wood or light iron, a little curved, and fastened to the mast to keep it steady at a short distance from the wall. C a good-sized pulley, say 6 or 7 inches in diameter, to move with ease and little friction, with side pieces to keep the cord in its place. D the car, consisting of two light but strong frames of oak, one each at top and bottom *e e*; the sides and bottom *f f f*, being of strong sacking, to render it light and flexible for use and convenience in carriage. These frames are united to runners *g g*, which slide over the mast; *h h h h* are cords to support the upper frame of the car, and are united at the top to another runner. These cords will form useful handles to assist a person while getting out of a window. The whole of this apparatus is finally fastened to the main cord I, which goes over the pulley.

The superiority of this contrivance consists in the simplicity of its application; for it is no sooner raised against the wall of a house on fire, than it is ready for use; and a man may be hauled up to a window, or *lowered from it, in one minute after the mast is brought to the* house; and children or infants may be placed in it and conveyed down, without the least danger; and many cargoes may be saved in a few minutes.

All other contrivances which I have seen described, require some minutes, at least, to prepare, before they can be used. Such, for instance, as throwing up a cord to the person in the room, who must then draw up the principal apparatus, and find some means of fastening it securely to a bed-post or window-frame, &c. All these operations take time, and must be performed by the persons in danger, who are generally too much distracted by their situation, to possess sufficient calmness and presence of mind to attend to the instructions given them by those in the street below; to say nothing of the incompetence of many females or children, to obey any instructions given to them in such a case. But when the Fire Mast is used, a man may be sent up, who can assist a whole family to descend in a few minutes, before any other escapes could be fixed and made ready for the purpose.

I likewise think, that the appearance of this contrivance, when presented at the window, would inspire even a timid female with confidence in the safety of such a conveyance.

Should the plan I now offer to your notice be eventually adopted, I would suggest the propriety of having one in readiness in every street, and of shewing and explaining its use to all the residents, and especially to females. A small subscription by every inhabitant in a street, would defray the expense of all the necessary apparatus, and the mast might be hung up in some convenient entry or passage, as is commonly done with ladders, and the car and cord deposited in some house adjoining; a small sign with *Fire Mast* painted upon it, might also be placed over the place where it is deposited. I would likewise recommend the inhabitants to avail themselves of its use to convey furniture in or out of the windows of upper rooms, instead of ladders; this would keep the machine in order, and likewise give them some experience in using it. I am, &c.

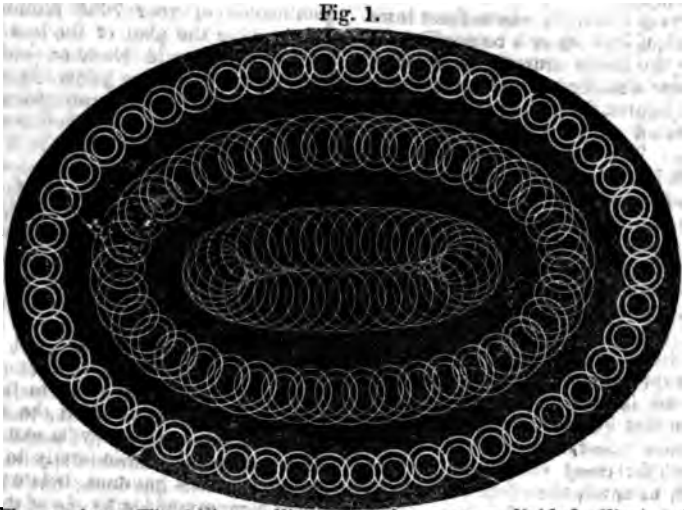
A. TAYLHILL.

Birmingham, June 28, 1820.

SPECIMENS OF ORNAMENTAL TURNING, BY MR. CHAPMAN.

Sir,—You had the goodness some time ago to insert in your interesting Magazine a communication, with specimens of ornamental turning, which I sent you some time since; I now beg to trouble you again to do me the like favour.

Fig. 1.



The specimen (Fig. 1.) is an ellipsis divided by eccentric and other geometric figures. My apparatus is capable of effecting this, whether the ellipsis be generated by the geometric, or common elliptic chuck, or by any other means that I am at present acquainted with; and it will produce not only any of the figures contained in my former specimens, but others, at the option of the workman, with as much ease and facility as circles.

I have had a dispute in my own mind whether it would be right in me to shew you a divided ellipsis, after the same thing had been previously done by others, but I assure you I had the method I make use of to invent, not knowing the method of any other person. Besides, Mr. Ibbetson has not said that his method is applicable to the dividing the ellipsis that is generated by the common elliptic chuck; and I believe there are many amateurs, as well as professional turners, who would like to know that an ellipsis so generated may be divided.

Fig. 2.

The specimen (fig. 2) consists of continued line figures, which any of your correspondents that dispute the originality of my apparatus may copy if they please; I only hope they will do it to the very letter, for where there is not much, a little is worth contending for. The two inside figures, although they appear detached, are continued motion figures, that is, the tool and block operated on were in continued motion. The outside circle of chain-work is all in one, and but one line, although without very close examination the contrary may appear to be the case. I hope the figures are sufficiently egg-shaped to serve as an answer to Mr. Alexander's query, No. 294, being neither at right angles nor parallel to a radius line. I do not imagine he is so unreasonable as to expect that every egg should be placed in a different position, but even that I could do, though it would require rather a troublesome adjustment for every change of position, and, after all, the effect would be by no means ornamental.

Now, Mr. Editor, I wish to say a few words to you, before I conclude, concerning the ground of preference you give Mr. Ibbetson's specimens. You say that in the way of turning you never saw any thing that equalled those of Mr. I 's chuck in *minute perfection of execution.* I suppose you mean small figures on small blocks; if so, I must say this is no criterion of superior excellence in the art, but the reverse, for it is well known to every turner on the lathe, that the more distant from the centre of rotation the tool operates on the work, the more liable it is to vibrate; a difficulty which will more particularly apply in this case, where there is a number of wheels, centres, &c., between the power and resistance. If the figures be large, the errors, if any, will be the more easily detected, and *vice versa.*

I wish farther to observe, that I have seen a great many very good lathes and their appendages, but they all dwindle down into insignificance when compared with one belonging to Sir Thomas Frankland, of Thirkleby Hall, in this county, which I once had the pleasure to see, and which I *may truly say is a master-piece* in turning apparatus. It cost, I was told, nearly £1,100.

I am in possession of both simple and compound geometric chucks, which I constructed shortly after the publication of your 72nd Number, nearly after the plan of the leading article of the said Number, which appears to be in some points superior to Mr. Ibbetson's; for I can generate cycloids and spirals, both circular and elliptic, which Mr. Ibbetson says *he cannot.* I am likewise in possession of another apparatus, which I made, I believe six years since, which is capable of generating all the curves the simple geometric chuck can generate; and this instrument I sometimes use in combination with the simple chuck, in which case they are in some points more than a match for the double or compound chuck. Now, Sir, with all this apparatus, and the practice I have had in the line, I should be a very dunce if I could not shew you as many hundred specimens as Mr. Ibbetson has done; but when done, there would not be one of them that I could with confidence say was new. I sent you my last specimens, under the impression that they were quite original figures generated by an original apparatus; which impression (after all that has been said and done since) remains as strong as ever. I will not be so absurd as to imagine they cannot be imitated—whatever has been done by one person may be done by another—but Mr. Ibbetson, at least, has not hit the mark, as his specimens in your 291st Number may lead you to imagine; they are quite of a different character, as I can shew, by his own reasoning, if necessary.

Still, in all these lathes that I have seen, there was not any thing that in any way resembled my apparatus; neither have I seen any specimens or figures, that have been printed from either wood, copper, or steel, that in any respect resemble them. I do not include what the apparatus is able to execute in imitation of other machines, such as the geometric chuck, eccentric, fly, or rose engines. In imitation of the rose-engine, I believe its powers to be unlimited, for I have not seen any figure-work that is composed of waved lines, however intricate, but

what it would be able to execute, in the hands of an ingenious and persevering artist.

I am, your's, respectfully,

GEORGE CHAPMAN.

Whitby, July 13, 1829.

[Mr. Chapman has not understood the words, "minute perfection of execution," exactly in the sense we used them. What we meant to say was, that most of Mr. Ibbetson's specimens are so perfect, that not even the minutest deviation from perfect correctness can be detected in them; and this holds equally true, whether the figures are large or small. The fig. 1, which Mr. Chapman now offers as a specimen of a divided ellipsis furnishes at hand an excellent illustration of our meaning. The division appears at first sight to be perfectly exact, but on a closer inspection very great inequalities may be perceived. Now, the superiority of Mr. Ibbetson's specimens consists in this, that they will stand any investigation. Mr. Chapman, we should say, divides an ellipsis well, Mr. Child still better, Mr. Ibbetson the best of any.]—ED.

ON THE MEANS OF GENERATING SPIRALS, AND ON COMPOUND GEOMETRIC CHUCKS. BY MR. CHAPMAN.

Sir,—I have just received the 78th Part of the Mechanics' Magazine, in which I observe a paper by your correspondent, Mr. Ibbetson, in which he asserts the impossibility of a chuck on a lathe being capable of generating spirals and some other curves, which he names. Now, Sir, I beg to observe, that I am in possession of a simple geometric chuck, and, as I said in a former communication, upon nearly the same plan as the one that is given in your 72nd Number, by which I can generate any of the curves so positively disputed. I will say, for instance, spirals of any number of turns. In fact, the thing is so simple, that it was one of the very first curves which I saw with the eye of my mind, the instrument was capable of generating, before I even took one single step towards the construction of the engine. But as simple assertion is not allowed to have any weight, and even specimens are sometimes termed patched impositions, I will proceed to inform you, and any of your readers that are in possession of a geometric chuck, how the spiral may be generated.

For example—place on the headstock a wheel of 84 teeth (or any other number, at pleasure, to suit the number of turns the spiral is to have); to act *in this wheel apply one* of 21 teeth on the arbor, and on the opposite end of the arbor place another wheel of 72 teeth, to turn another wheel of 36 teeth, which must be fixed on the principal arbor of the chuck. Now, to generate the spiral, the mandrils of the lathe should only, make half a revolution. To give the mandril a *full* turn will produce another similar spiral, but the reverse to the former, and the line will return into itself if the wheels be of the above numbers, or any other number that divide properly; which is another property the spiral possesses, though that has been disputed.

The foregoing being properly understood—which I think it will readily be by any one in possession of a compound geometric chuck—he will easily perceive how an elliptical spiral may be generated; and if he is in possession of an apparatus that will divide the ellipsis upon the same principle of the one that I possess, he will also see that the circular spiral may be divided into any number of equal parts. Now, Sir, all this and much more—pursuing the same path through all its varieties—may be done, and has been done, notwithstanding all that has been said to the contrary.

In my former papers, as well as in this, I have frequently adverted to the *compound or double geometric chuck*, but perhaps some of your readers may not have properly understood my meaning. To be more explicit, I wish to observe, that persons who possess a single chuck, and having rung all the changes they can think of by it, may wish for something new in the art, may have this to their heart's content, (if not very unreasonable) by fixing a duplicate or second geometric chuck on the nose of the former, and giving the second motion from the first, in the same manner that the first has its motion from the head stock.

I have been in possession of the above chuck, that is, a compound geometric chuck, a long time; in fact, I made the second a very little while after the first, and the reason that I never gave an explanation of it before, is, because the idea came so easily, and appeared so natural, that I thought the same thing must have

occurred to many others as well as myself, and was not therefore worth communicating.

As the above combination, however, has never (as far as I am aware) been yet noticed by any one, either under the name I have given to it, or any other, I presume I may claim the merit (if there be any) of combining two simple epicycloidal chucks (as they are called in the French Manuel du Tourneur, published in 1816, and Mechanics' Magazine, No. 72.) It is no matter if the candle has been burning elsewhere, or how long previous to the date of this communication; it has been under a bushel, and so could not have given any light to me, or any other person. If, therefore, any claim should be set up to priority of invention, it cannot have any weight.

If the above information should be considered of any value by any of your numerous readers, I shall feel great pleasure when I reflect that I have added a trifle to the general stock of amusement and gratification which such pursuits offer, and may probably be encouraged to trouble you with some account of other apparatus at a future time.

Your's, &c.

GEORGE CHAPMAN.

Whitby, Aug. 10, 1829.

HARDENING THIN STEEL PLATES.

To Mr. R. Daniell.

Sir,—In No. 314, of this Magazine, you answered the inquiry of a "Plain Mechanic," respecting the hardening of thin steel plates without warping; and if you can give any information on the following analogous subject, you will oblige many as well as myself.

How are pieces of thin steel (similar to warding-files) hardened without warping them? Or can you tell me the method which file-makers adopt to prevent the warping of their small files in hardening?

If the process is no secret of trade, and you (or any other person) will give it publicity by means of this Magazine, you will confer a lasting obligation on many of the sons of Vulcan.

Isle of Wight. C. C.

P. S. F. D. in No. 311, has kindly answered an inquiry of mine respecting the repairing of globes, but if he will insert the address of the maker* he alluded to, and the probable amount of re-covering my globes, I shall feel greatly obliged.

* [In the answer of F. D. as originally communicated to us, the address of the maker, (one William Newton,) was given; but we struck it out for two reasons. First, because the insertion of the address would have been an advertising of the said Newton, and have subjected us to the advertisement duty; and second, because the said Newton is the man who prosecuted a brother journalist (to the death almost), for copying without his leave, certain drawings, which he (Newton) had himself borrowed from that public repository, the Patent office; and is therefore a person whom we have no disposition to oblige, in any way—not even to the extent of obtaining him an order to renovate a pair of globes. —ED. M. M.]

INDIAN MODE OF CUTTING PRECIOUS STONES.

Sir,—I perused a paper in your valuable Magazine (No. 178, vol. vii.) "On the Improvement of the Lathe, and an Inquiry respecting its Application to the Cutting of Stones." Not having seen it elsewhere, I think a description of the simple mode which the natives of India adopt for the purpose of slitting stones, preparatory to their being polished, may not be unacceptable to some of your readers.

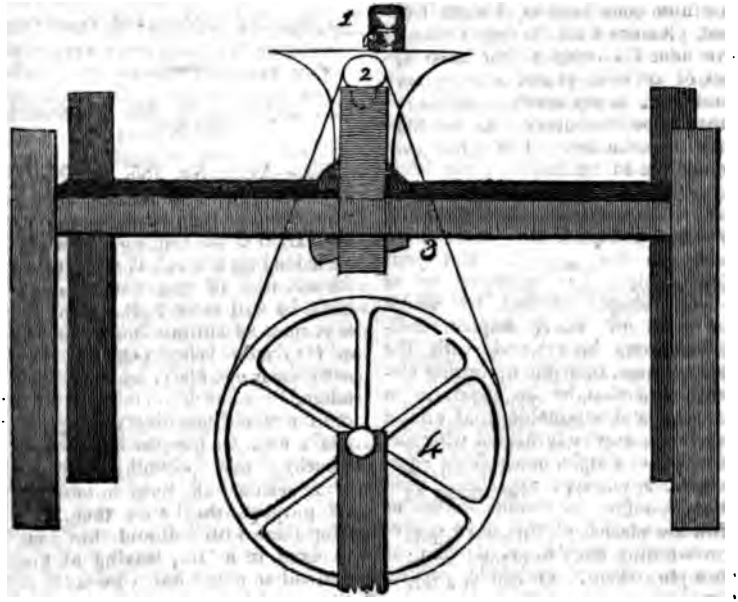
The native lapidaries throughout India are very expert in the process of cutting and polishing pebbles. Having selected the most suitable to their purpose, they slice them, by sawing them with soft and thin iron wire fixed in a bow, leaving at the end a coil to renew the wire as it is worn away by the friction. The workman having seated himself on the ground, drives into it a piece of bamboo about a foot long; in this he makes a slit vertically, to fix the pebble upon which he is to work. He then places an earthen cup of water, and another of coarsely powdered corundum (sometimes only sand), on his left; and having taken the bow in

his right hand, and wetted the fore-finger and thumb of his left hand, he applies the powdered corundum every now and then to the wire, as he saws the stone; and by a little practice, the stone is cut very evenly through.

Although this plan, owing to the expense of manual labour, might not answer for mechanics generally, in England, yet children of both sexes might be employed very beneficially in sawing the stones, by the foregoing very cheap and simple process, preparatory to their being polished. The labour is nothing, the means available, and the method easily taught.

I myself, some years since, for amusement, prepared, very speedily, pebbles for a necklace, by employing boys not more than from six to eight years of age; and many an idle and starving boy in England might be made to earn his own bread in a way, perhaps, less objectionable than many others.

It is possible, that your correspondent before alluded to, might be able to construct a frame with a fly-wheel, to carry a thin wire over a pebble to be cut; which, instead of revolving on the mandril, should remain fixed, allowing the wire to revolve over it, furnished with a guide, and having a mixture of emery and water falling upon it. The friction of the wire would, similarly, soon cut into the stone. The fly-wheel should be so arranged as to tighten or slacken the wire, as the work might require. I am no draughtsman, but the following sketch may explain my meaning:—



Description.—1, Pan for water and emery; 2, Pebble fixed; 3, Wedge to tighten the work; 4, Fly-wheel, to move by the foot or a handle.

I remain, Sir, your's, &c.

Benares, Feb. 1829. AN AMATEUR.

FIRE-PROOF ROPE LADDERS.

Sir,—The information afforded by *Mr. Wansbrough, in Number* 314, of the Mechanics' Magazine, respecting the means of securing ropes from combustion, I conceive to be of the

highest importance; and, as such, I would recommend it to the particular notice of your correspondents, and to the mechanical world at large.

Through the medium of your Magazine, I would suggest to them the consideration of the numerous and extensive advantages that would doubtless arise from the general introduction of such an improvement in the construction of all descriptions of ropes, especially those which are more particularly exposed to the action of fire.

Now, as that portion of the public mind which conducts your interesting work, has been of late very much engrossed with various methods for best securing that most desirable object—the preservation of human life—it will not be unseasonable for me to offer any hint by which I may successfully contribute to this great object. Amongst all the ingenious and excellent fire-escapes that have appeared in your pages, I have seen none that, in my opinion, at all balance in point of merit with the common rope-ladder. The great objection raised against this, has been, its great liability, in most cases of fire, to be consumed in the flames, ere the inmates can descend in safety to the ground. But your correspondent has informed us of a very simple method by which the lives of many hapless individuals may be rescued, with the greatest ease, from the devouring element, and that by an apparatus so common and attainable, that almost any house may be furnished with one, namely, a simple *ammoniated rope-ladder*. No more, I apprehend, need be said either in commendation or recommendation of this most convenient family fire-escape, it being at once so useful, attainable, secure, expeditious, and cheap.

Hoping that the above suggestion will meet with the sanction of your readers, and be followed up by its being very generally adopted,

I remian,

Sir, your's, &c.

W. H. B.

Beaminster, Sept. 9, 1829.

P. S. It has occurred to me, since writing the above, that it would be an additional improvement, if each end of the ladder were brought to a point, and there attached to a strong iron ring, to which a large hook might be fastened at one end, for the purpose of securing it to any part of the building; and, at the other, a heavy weight might be hooked on or removed, as might be required. This would be found of great utility in cases of emergency, when no one might be present to hold the lower end of the ladder, as it would keep it firm, and thus render the descent steady and secure. A small grappling-iron might be employed with advantage where the ground beneath is not impenetrable.

METHOD OF PREVENTING THE MOTION OF STEEPLES FROM AFFECTING THE RATES OF CLOCKS.

(4th Rejoinder by Mr. Harrison to Mr. Wynn.)

Sir,—As in No. 285, p. 405, Mr. Wynn continues to insist on having "practically annihilated *the whole* of the friction of the dial-works and their leading trains," it only remains for me, with all proper respect, to request he will explain to us how it is, that since he can annihilate *the whole of the friction between two wheels, the one driving the other*, he has not extended the same desideratum throughout the whole machinery of the dial-work, nay, to the clock itself, and thereby obviated almost the necessity of applying any weight. The one thing must just be as easy as the other. If he cannot be prevailed upon to oblige us in this small matter, he had better never have hazarded the assertion he has done.

I can readily assent to Mr. Wynn's assertion respecting any force by which the pointers might be accelerated or retarded, not being communicated to the movement: but instead of saying, not an atom of that force would reach the movement, I believe he would have been more correct had he said *it would have no sensible effect* on the movement. I applied what

would act precisely similar to his description (and therefore cannot doubt of its being the same thing) to a church clock many years ago, for the purpose of keeping it going during the time of winding up the weight. Its principle is the same as what clock-makers call *a going ratchet*, and was effected by a clock-spring on the second axle in a circular box, like the springs of those house-clocks which go by springs instead of weights—one end of the said spring being attached to the axle, as an arbor, and the other end to the circular box containing it; the second wheel was fixed upon this box. On holding up the click of the ratchet, the first wheel and pinion might be made to move backwards and forwards, even to more than one round of the pinion, by the application of a very small force, without any perceptible effect on the rest of the movement, which kept going just the same as usual; consequently, had the pointers been attached to this axle, they must have had the same motion as far as the apparatus for releasing the striking part would have permitted. Hence by the application of a ratchet and click, Mr. W. may make the same thing subservient to the purpose of impelling the clock during the winding up of the weight. The second axle, however, best suiting to attach the pointers to, and there appearing *a sufficient reason for not attaching them to it when their communication with the movement was through this spring*—the clock alluded to was the only one to which I ever adapted the going ratchet in this manner; and I doubt not, but Mr. W. will discover the reason which deterred me from applying it to the same purpose he intends, should he proceed to put his intention in practice: in short, I believe he will find that the pointers will scarcely ever be right, but will be either too forward or too backward, according to the yielding of the spring. This is very evident of Mr. W., namely, that he is possessed of considerable inventive powers, and of an active mind; but as every ingenious invention is not an improvement, judgment is as necessary in determining on such matters, as a right apprehension of the laws of mechanics is in avoiding disadvantages and mistakes.

As to Mr. W.'s clock-pendulums *not being affected by the rocking of steeples*—it is certain, that whether the Boston clock-pendulum is affected or not, the cock, or supporter on which the pendulum hangs, partakes of the motion of the steeple: it rests with himself, therefore, to shew by what means the motion of the cock affects not the motion of the pendulum, since *the desideratum which he has the means of offering to the public*, is not applied in this clock. In truth, I can have no doubt respecting this assertion being equally correct as that of his having annihilated the whole friction of the dial-work, and, consequently, it is not to be expected that he can be induced to *divulge this secret* any more than the other. I believe it would pose a greater philosopher than Mr. W. to discover the means of fixing a clock on any foundation having motion, and yet preventing that motion from being communicated to the clock. My method of preventing the motion of steeples from affecting the going of clocks, is by fixing the watch part at the bottom, *where there is no motion*, as I have before described in my design for such steeples as Boston's.

I will in this place take notice of a passage in Mr. Reid, of Edinburgh's, valuable Treatise on Clock and Watch-making. On an occasion of referring to *the ill-going* of some of the first clocks with seconds' pendulums, Mr. Reid says, p. 184, "This (ill-going) arose from the great extent of the arc of vibration, the lightness of the pendulum-ball, the great dominion which the clock had over the pendulum, and the bad effects of the cycloidal checks, which however excellent in theory, were never found useful in practice."

Now, though I am no advocate for an immoderate range of the pendulum, and though, according to the modern mode of adapting regulators, the pendulums swing in such small arcs as not to need cycloidal checks —(which being the most simple, there can be no question is the best way)— yet it is not an absolute fact, that cy-

cloidal checks have *never* been found useful in practice. The two regulators for the time-piece have cycloidal checks; their pendulums are compensated upon the gridiron principle, and they range in an arc of more than 15 degrees! but notwithstanding the largeness of the arc, these regulators kept time with an accuracy sufficient for the intended purpose; and I cannot doubt of its being readily allowed, that those pendulums, moving in such a large arc as to occasion the cycloid and the circle to differ so much, would have rendered it impossible for them to keep time with the most ordinary clocks, had it not been for the property of the cycloid.

The principle of the scapement of these clocks is the same as Mr. Reid has explained; and it was this scapement in one of those clocks of Harrison's of which Mr. R. inquires, p. 206, of whose going Mr. Short said, "That he could depend on it to one second in a month," and "that it had been going for fourteen years at this rate?" It consequently does not remain to be proved "whether the great recoil which it has, may not be against the time-keeping of the clock."

It is to be observed of these clocks, that they never want cleaning, no oil being required in any part. Their pivots are *tempered brass*, and move in bushes of *box wood;* and, instead of leaves, the pinions have *rollers of lignum vitæ*, which turn upon *brass pins*. The friction of the pivots is undoubtedly greater than those of steel moving in brass with oil, but then there is the advantage of its being always the same.

As to the "ticklish balancing of the pallets," which Mr. R. mentions, I do not conceive there to be any difficulty attending this matter. I have known some curious persons of other professions, particularly a hatmaker and a cabinet-maker, who having seen this scapement, made some in imitation, which perform as well as the original. It seems, however, that Mr. R. has never seen this scapement, because the drawings he has given of it are so exceedingly distorted as to have no resemblance to the reality: whence it is natural to conclude, that those drawings are the result of his own ideas of the manner of applying those principles, though the mode appears to me to be very ungainly. On the contrary, the verge in those clocks is placed over the wheel in the usual manner of pallets, and the impulse is communicated by one of the pallets thrusting the wing up and the other pulling it down. The principle is the same as that of the scapement in the turret-clock at Brocklesby, described in No. 304, p. 264, and in which the verge is also directly over the wheel; only in that clock the impulse is given by two thrusts—in those regulators it is effected by a thrust and a pull.

JAMES HARRISON.

Barton-upon-Humber.

THE CAOUTCHOUC EAR TRUMPETS.

Sir,—I have read the notice in your number 312, page 400, respecting the acoustic tubes, (there called ear trumpets,) and in consequence got a friend to call at Mr. Fores's, in Piccadilly, to inquire into the fact, and he informs me, that true it is, a tube may there be purchased for fifteen shillings, but that it is very short, and that a tube of the same length as the one I purchased of Mr. Poynter, is charged the same price, viz. two guineas. I conceive the utility of the instrument very much depends upon its size, and that a short tube is not so powerful as a long one. One of the great uses I make of mine, is at and after dinner. It lies on the table; any person inclined to speak to me takes hold of it; that is a signal to me to apply the tube to my ear, and thus I can converse with a person across the table, with great ease, and without disturbing other people. Now I could not do so with a short tube.

I therefore strongly recommend all deaf persons who are inclined to purchase a tube, not to content themselves with one of a low price, or of a short length.

I am, &c.

CUMBRIA.

A TABLE

OF NATURAL SINES, COSINES, TANGENTS, COTANGENTS, SECANTS, AND COSECANTS,

TO EVERY DEGREE OF THE QUADRANT.

Deg.	Sines.	Cosines.	Tangents.	Cotangents.	Secants.	Cosecants.	
0	00000	1·00000	00000	Infinite.	1·00000	Infinite.	90
1	01745	99985	01745	57·2900	1·00015	57·2987	89
2	03490	99939	03492	28·6363	1 00061	28·6537	88
3	05234	99863	05241	19·0811	1·00137	19·1073	87
4	06976	99756	06993	14·3007	1·00244	14·3356	86
5	08716	99619	08749	11·4301	1·00382	11·4737	85
6	10453	99452	10510	9·51236	1·00551	9·56677	84
7	12187	99255	12278	8·14435	1·00751	8·20551	83
8	13917	99027	14054	7·11537	1·00983	7·18530	82
9	15643	98769	15838	6·31375	1·01246	6·39245	81
10	17365	98481	17633	5 67128	1·01543	5·75877	80
11	19081	98163	19438	5·14455	1·01872	5·24084	79
12	20791	97815	21256	4·70463	1·02234	4 80973	78
13	22495	97437	23087	4·33148	1·02630	4·44541	77
14	24192	97030	24933	4·01078	1·03061	4·13356	76
15	25882	96593	26795	3·73205	1·03528	3·86370	75
16	27564	96126	28675	3·48741	1·04030	3·62796	74
17	29237	95630	30573	3·27085	1·04569	3·42030	73
18	30902	95106	32492	3.07768	1·05146	3·23607	72
19	32557	94552	34433	2·90421	1·05762	3 07155	71
20	34202	93969	36397	2·74748	1·06418	2·92380	70
21	35837	93358	38386	2·60509	1·07114	2·79043	69
22	37461	92718	40403	2·47509	1·07853	2·66947	68
23	39073	92050	42447	2·35585	1·08636	2 55930	67
24	40674	91355	44523	2 24604	1·09464	2 45859	66
25	42262	90631	46631	2·14451	1·10338	2·36620	65
26	43837	89879	48773	2·05030	1·11260	2·28117	64
27	45399	89101	50952	1·96261	1·12233	2·20269	63
28	46947	88295	53171	1·88073	1·13257	2·13005	62
29	48481	87462	55431	1·80405	1·14335	2·06266	61
30	50000	86603	57735	1·73205	1·15470	2·00000	60
31	51504	85717	60086	1·66428	1·16663	1 94160	59
32	52992	84805	62487	1·60033	1·17918	1·88708	58
33	54464	83867	64941	1·53986	1·19236	1·83608	57
34	55919	82904	67451	1·48256	1·20622	1·78829	56
35	57358	81915	70021	1·42815	1·22077	1·74345	55
36	58778	80902	72654	1.37638	1·23607	1·70130	54
37	60181	79863	75355	1·32704	1·25214	1·66164	53
38	61566	78801	78129	1·27994	1·26902	1·62427	52
39	62932	77715	80978	1·23490	1·28676	1·58902	51
40	64279	76604	83910	1·19175	1·30541	1·55572	50
41	65606	75471	86929	1·15037	1·32501	1·52425	49
42	66913	74314	90040	1·11061	1·34563	1·49448	48
43	68200	73135	93251	1·07237	1·36733	1.46628	47
44	69466	71934	96569	1·03553	1·39016	1·43956	46
45	70711	70711	1·00000	1·00000	1·41421	1·41421	45
	Cosines.	Sines.	Cotangents	Tangents.	Cosecants.	Secants.	Deg.

PORTABLE TRIGONOMETRY, WITHOUT LOGARITHMS.

In all the more elaborate and refined operations of trigonometry, as well as their applications to navigation, astronomy, and geodesic surveying, it is not only desirable, but necessary, to employ some of the larger logarithmic tables, as those of Hutton, Babbage, Callet, Taylor, &c., both to save time and to ensure the requisite accuracy in the results. But, in the more ordinary operations, as in those of common surveying, ascertaining inaccessible heights and distances, reconnoitring, &c., where it is not very usual to measure a distance nearer than within about its thousandth part, or to ascertain an angle nearer than within 2 or 3, or in very rare cases within 1 minute, it is quite a useless labour to aim at greater accuracy in a numerical result. Why, for example, should I compute the length of a line to the 4th or 5th place of decimals, when it must depend upon another line, whose accuracy I cannot ensure beyond the unit's place? Or, why compute an angle to seconds, when the instrument employed does not ensure the angles in the data beyond the nearest minute?

Hence several mathematicians, as Euler, Legendre, Hutton, Bonnycastle, &c., have investigated approximating series and other rules, for solving the cases of trigonometry without tables; yet, however ingenious their researches may have been, they have not led to any results of practical value, but simply furnish so many proofs how easy it is for scientific men, in their investigations, to miss the point of real utility.

It is truly extraordinary, that amid all this search for expedients, the obvious method which I now beg to recommend and exemplify, has never been thought of. In the table which precedes this article, and which, set up with a bold, clear type, occupies only an octavo page, I have brought together the *natural* sines, tangents, and secants, to every degree in the quadrant; and have no doubt that this table, though only carried to *five places of decimals*, will be found sufficiently extensive and sufficiently correct for the various practical purposes to which I have adverted. And thus, the surveyor, the architect, the civil or military engineer, furnished with this table, in one page, with a box and 100 feet tape, a pocket sextant, or Schmalcalder's elegant portable theodolite, may take every angle and perform every computation that can occur in the most useful cases.

The requisite proportions must, it is true, be worked by multiplication and division, instead of by logarithms. Yet this by no means involves such a disadvantage as might seem at first sight. For when the measured lines are expressed by three, or at most by four figures, (and to give more, only presents an appearance of accuracy which does not exist) the multiplications and divisions are performed nearly as quick, and in some cases quicker (as will be seen) than by logarithms. Besides which, the operations may often be shortened, by resolving numbers into their component factors, and by other contractions well known to practical men. Nay, if this were not the case, the circumstance would not present any serious objection: for, when a computation is not to be performed once in a month, it does not greatly signify whether you complete it in ten minutes or in twenty.

Then, as to accuracy: even in cases where the computer will have to take proportional parts for the minutes of a degree, the result may usually, if not always, be relied upon to within about a minute: and, recollecting that in the out-of-door operations he has it commonly at his option to fix his instrument at angles measured by *degrees* precisely, by simply advancing or receding for vertical angles, or moving to the right or left for horizontal ones, or a little varying the position of a station-staff; thus at once ensuring a simplified calculation and a more accurate result. The accuracy will also be augmented by some of the expedients which I shall explain as I go along.

The Table.

The table is so arranged, that for angles not exceeding 45 degrees, the

sine, cosine, tangent, cotangent, &c., for any number of degrees, will be found *opposite* the proposed number in the *left hand* column, and in the column under the appropriate word. When the number of degrees in the arc or angle exceeds 45°, that number must be found in the *right hand* column, and *opposite* to it in the column indicated by the appropriate word at the *bottom* of the table. Thus, the sine and cosine of 36° are ·58778 and ·80902 respectively, the tangent and cotangent of 62° are 1·88073 and ·53171 respectively; the radius of the table being unity, or 1.

The taking proportional parts for minutes, can only be done correctly (that is, independently of the rules of interpolation) in those parts of the table where the differences between the successive sines, tangents, &c., run pretty uniformly. In that case, the mode to be employed will be evident from a single example. Suppose we want the natural sine of 20° 16′. The sine of 21° is 35837, that of 20° is 34202; their difference is 1635. This divided by 60 gives 27·25, for the proportional part due to 1 minute, and that again multiplied by 16, gives 436, for the proportional part for 16 minutes. Hence the sum of 34202 and 436, or 34638 is very nearly the sine of 20° 16′. And so of others. But observe that the operation may often be contracted by recollecting that 10′ are $\frac{1}{6}$, 15′ are $\frac{1}{4}$, 40′ are $\frac{2}{3}$ of a degree, and so on. Observe, also, that for cosines, cotangents, and cosecants, the results of the operations for proportional parts are to be *deducted* from the value of the required trigonometrical quantity in the preceding degree.

Useful Theorems.

1. cosine $= \sqrt{(1 - \sin^2.)}$
2. sine $\div$ cosine $=$ tangent.
3. cosine $\div$ sine $=$ cotangent.
4. $\sin.^2 + \cos.^2 = \text{rad.}^2$.
5. $\text{rad.}^2 + \tan.^2 = \text{secant}^2$.
6. $1 \div \tan.$ $=$ cotangent.
7. $1 \div$ cotan. $=$ tangent.
8. $1 \div$ sine $=$ cosecant.
9. $1 \div$ cosine $=$ secant.
10. $1 \div$ cosecant $=$ sine.
11. $1 \div$ secant $=$ cosine.
12. rad. $-$ cosine $=$ versin.

Thus, we may often, instead of dividing by a sine multiply by the cosecant; instead of dividing by a tangent multiply by the cotangent of the same arc; and so of others.

Right-angled Triangles.

1. $(\text{hypoth.})^2 = \text{base}^2 + \text{perp.}^2$
2. $\text{base}^2 = (\text{hypoth.} + \text{perp.}) \times (\text{hypoth.} - \text{perp.})$
3. $\text{perp.}^2 = (\text{hypoth.} + \text{base}) \times (\text{hypoth.} - \text{base.})$
4. perp. $=$ base $\times$ tan. angle at base.
5. hyp. $=$ base $\times$ sec. angle at base.
6. perp. $\div$ base $=$ tan. angle at base.
7. base $\div$ perp. $=$ tan. angle at vertex.
8. hypoth. $\div$ base $=$ sec. angle at base.
9. hypoth. $\div$ perp. $=$ sec. angle at vertex.
10. base $\div$ hypoth. $=$ cosine angle at base.
11. perp. $\div$ hypoth. $=$ sine angle at base.

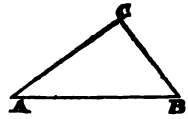
Plane Triangles, generally.

Case 1. When a side and its opposite angle are two of the given parts.

Then, as any one side, is to the sine of its opposite angle; so is any other side, to the sine of its opposite angle.

The first term of the proportion must be the sine of a given angle, whose opposite side is also given, when a side is required. If an angle is required, begin the proportion with a given side opposite a given angle.

Remember, that the three angles of every plane triangle, when added together, make precisely 180 degrees.



Case 2. When two sides and the angle included between them are given to find the third side: as suppose AC, AB, and the angle A are given. Then $CB = \sqrt{(AC^2 + AB^2 - 2AC \cdot AB \cdot \cos. A)}$. After CB is thus found, the angles C and B, if required, may be found by the rule in the 1st Case.

Case 3. When the three sides are given, to find the angles. Find one angle, as suppose A, by the theorem,

$$\cos. A = (AC^2 + AB^2 - BC^2) \div 2AC \cdot AB;$$

then another angle by the rule to the 1st Case, and the third angle by taking the sum of the other two from 180 degrees.

Sometimes it will be better to determine one of the unknown angles by means of a theorem for its *half*. Thus, if half the sum of the three sides be denoted by S, we shall have

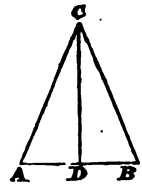
$$\sin. \tfrac{1}{2} A = \sqrt{\frac{(S - AB) \cdot (S - AC)}{AB \cdot AC}}$$

I have thus brought together the most useful rules in plane trigonometry, that your practical readers may have all the requisite information before them in one place; and shall now conclude with a few examples in

Heights and Distances.

And here, for the sake of facilitating the comparison with a well-known book, I shall select from the second volume of "Hutton's Course of Mathematics."

Ex. 1. Two stations, A and B, are assumed in a horizontal plane, and it is required to find their distance from an inaccessible object, C, in the same horizontal plane.



AB is measured=200, the angle A is found to be 68° 2′, and B=73° 15′. Required AC and BC. (Hutton, p. 24.)

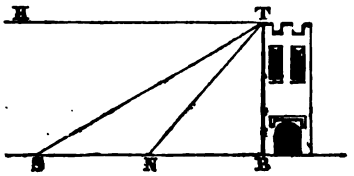
Here 180° − (A+B)=38° 43′=C. Then, proportioning as before explained for the minutes, we have sine C=sin. 38° 43′=·62545; sin. A=sin. 68° 2′=·92739; sin. B=sin. 73° 15′=·95755. Then, working with these numbers and AB=200, we have, from Case 1,

sin. C : AB :: sin. B : AC=306·19; Dr. H.'s answer is 306·19.
sin. C : AB :: sin. A : BC=296·55; Do. 296·54.

I omit the work at large to save room.

Note. In a great majority of cases, an inaccessible distance may be obtained by a still simpler process. Thus, choose the first station at D, so as to make a right angle CDA with *the line AB: then* set the sextant, or other instrument for measuring angles, to any suitable angle expressed in whole degrees, as 70°, 60°, 54°, 52°, 45°, &c., and retire from D along DA, until the angle CAD accords with that to which you have set the instrument. Then DC=DA × tan. A, and AC=DA × sec. A.

Ex. 2. From the top of a tower, by the sea side, of 143 feet high, the angle of depression of a ship's bottom was observed to be 35°: what was the ship's distance from the bottom of the wall? (Hutton, p. 25.)



In the annexed figure, where TH, BS, are horizontal, TB vertical, the latter is given=143: also angle HTS =35°, whence STB=90°—35°=55°. But BS is evidently the tangent of the angle STB to the radius TB. Hence BS=TB × tan. STB=143× 1·42815=204·22, agreeing with Dr. H.'s answer.

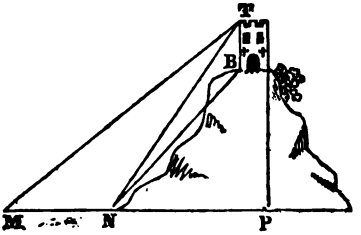
Ex. 3. Wanting to know the distance between two inaccessible objects NS (preceding figure) on a horizontal plane, the angles STB=64½°, NTB=33°, were taken from the top of a tower whose height BT was known to be 120 feet. Required NS. (Hutton, p. 24.)

Here SN is evidently equal to the difference of the tangents of STB and NTB, to the radius TB.

Now, the differences of the tangents above 60° increasing rapidly, the common use of the proportional parts would give the tangent of 64° 30′ too great. I therefore find the cotangent of 64° 30′=·477 nearly, and from the principle of theor. 7, find 1÷·477= 2·0964= tan. 64½°. The tan. of 33° = ·64941. Therefore, (2·0964 — ·64941) 120 = 1·44699 × 120 = 173·6388=SN. Dr. H.'s answer is 173·656, differing by about the 10,000dth part.

Ex. 4. Wanting to know the height of an inaccessible tower, I took two angles in the same vertical plane, viz. N=58°, S=32°, (preceding figure) and measured the horizontal distance NS between the stations =300. Required the height BT of the tower, and my distance NB from it at the nearest station. (Hutton, p. 25.)

In this case, by simply reversing the process in the last example, NS divided by the difference of the tangents of STB and NTB, or the difference of the cotangents of S and N will give BT; and BT × cot. N=BN. But cot. 32°=1·60033, and cot. 58°= ·62487, their diff.=·97546. Hence 300 ÷ ·97546 = 307·55 = BT; and 307·55 × ·62487=192·17=BN. Dr. H.'s answers are 307·53 and 192·15; and the logarithmic method requires 12 lines, besides turning to several different pages of the tables.



Ex. 5. In order to find the height of a tower TB, that stood on the top of a hill, at two stations N, M, whose horizontal distance measured 200 feet, I took the vertical angles PNB =40°, PNT=51°, and PMT=33° 45′, all in the same vertical plane. Required TB. (Hutton, p. 26.)

This example may be worked either by means of the tangents and cotangents, or by the sines; let us here employ the latter. Sin. MTN=sin. (TNP—TMP)=sin. 17° 15′= ·29654; sin. TMN = sin. 33° 45′ = ·55556, found by the proportional parts, as before described; sin. B=sin. 50°= sin. 130° = ·76604; sin. BNT=sin. (51°—40°)=sin. 11° = ·19081. With these numbers and MN=200, work the following proportions,

sin. TMN : MN :: sin. TMN : TN = 374·695
and sin. B : TN :: sin. BNT : BT = 93·3313. Dr. H.'s answer is 93·33148.

Ex. 6. Wanting to know the distance between two headlands, I measured from each of them to a certain point inland, *and found the two* distances to be 735 and 840 yards, and the horizontal angle between those two lines 55° 40′. Required the distance. (Hutton, p. 27.)

Here, referring to the figure in Case 2, Plane Triangles, there are given AC=735, AB=840, and angle A=55° 40′. Observe also that 735=105×7, and 840=105×8; and that, therefore, we may proceed as though AC were 7 and AB 8; multiplying the final result by 105.

The cosine of 55° 40′=cos. 55°—¼ diff. cosines of 55° and 56°=·564 very nearly. Hence, taking the expression in Case 2, we have

$$\begin{aligned} CB &= 105\sqrt{(7^2+8^2-2\cdot7\cdot8\times\cdot564)} \\ &= 105\sqrt{(49+64-63\cdot168)} \\ &= 105\sqrt{49\cdot832} \\ &= 105\times7\cdot06917 \\ &= 741\cdot21 \text{ yards.} \end{aligned}$$

Dr. H.'s answer is 741·2.

The above will suffice to exemplify the manner of operation, as well as to prove the accuracy of the method; which, as will thus appear, is greater than I have hypothetically assigned it.

In what is here done, I shall not, I trust, be supposed attempting to supersede the use of the excellent tables referred to at the commencement of this paper, or the correct theoretical processes which they so greatly facilitate. I am solely anxious to explode all the crude and usually erroneous tentative methods adopted by those who are not conversant with the nature and use of logarithms, by showing that, without the aid of those artificial numbers, a table of natural sines, tangents, &c., comprehended in a single page, will enable a computer by simple operations in decimal arithmetic, to solve problems in trigonometry, and inaccessible heights and distances, with all the accuracy that can be desired by practical men.

The same table will be found of equal utility in the mechanical inquiries which relate to the parallelogram of forces, oblique pressures, motions on inclined planes, the usual practice of gunnery, &c. But fearing that I shall have already greatly encroached upon your pages, I can only hint at these applications now.

I am not, however, without hopes that what is here done will stimulate some individual of more leisure than myself to turn his attention to the abbreviation of a table of *logarithms*. I have seen such a table in a single sheet, and M. Wronski proposed to reduce it to a single *page*. If, however, a correct table to five places of decimals could be presented in about *four pages*, then two more pages might contain such a table as the preceding, *and an* analagous table of logarithmic sines, tangents, &c. A single sheet might thus be made to exhibit all the tables, precepts, and rules, necessary in the common practice of trigonometry, and in the computation of annuities and reversions. Much shall I rejoice if some of your correspondents enable you to present to the public so valuable a gift.

August 25th. P. M. W.

ANCIENT GOLD COIN.

Sir,—Herewith you will receive tolerably correct drawings I have made of a gold coin, which was found a few days ago in a field near this place by a man hoeing potatoes. I should be obliged to any of your correspondents who would favour me with a description thereof. By giving this a place in your valuable Magazine, you will much oblige a constant reader,

H. S. Guy.

Symondsbury, near Bridport, Dorset, July 7, 1829.

ÆRIAL PROJECTS—ROYAL CONDOR COMPANY.

Sir,—In consequence of several amusing papers having appeared in your Magazine, upon the art of flying, I also have turned my attention to that interesting subject.

Before, however, I enter into any elucidation of my plan, allow me to offer a few remarks on the schemes of others. I shall pass over the speculations in the eighth volume, as no attempt was made to carry them into effect. I propose to confine my remarks to the two last, being more deserving of notice than any of the others. Your correspondent, M, (page 47, vol. x.) after a preamble about impostors of all degrees, miracle-mongers, prophets, Mahomet, Johanna Southcote, stupid credulity, sympathetic hostility, men who scoffed at Windsor, steam navigation, &c., announces that he has actually discovered the art of flying, which he says, will "form a new era in the moral and physical condition of mankind.' It appears further, that he is inclined to dispose of a fourth share of the honours and profits, which he says are "*incalculable*," for the very moderate sum of £1,500. There are two things in this announcement that rather puzzle me; first, how profits which cannot be calculated, are to be divided into shares; and second, how any share of an honour which cannot be divided, can be transferred to another. Your correspondent further says, "After two years of *labour* and experiments, I have succeeded in the construction of the necessary parts and *materials*, for exceeding in the requisite qualities of strength and lightness, any thing produced by nature." It would be strange indeed, if after two years *labour*, he had not brought forth something extraordinary; but from his production, one would suppose he had been only *hatching*. That your correspondent has constructed something of such materials as nature furnishes, we may admit without any sacrifice of our reason; but to believe, that he has constructed the *materials* also, surely requires no small share of credulity. Your *Hippon* correspondent is more modest in his pretension, but there is certainly a great deal of ambiguity in what he says about "agitating the *pressure* of the atmosphere," and again in his assertion that "when any body gets *sufficient velocity*, it overcomes its gravity, and the direct pressure of the air." The latter passage has almost overcome my gravity also; to say the least of it, it is exceedingly conglomerating. Your correspondent does not say, what is "sufficient velocity;" but we may presume he means between twenty or a hundred miles in an hour. Well then, let us suppose that the machine has somehow or other got up in the air, then if the machine is not specifically lighter than common air, it will descend through a certain space in some unit of time, and the same will take place, whatever the horizontal velocity may be; that is at the end of a unit of time, the machine will descend through equal spaces in equal times, whether the machine has a horizontal motion, or is allowed to descend from rest. What your correspondent says about "the direct pressure of the air" is quite unintelligible.

I will now, with your leave, proceed to give an outline of my *own* plan. Humboldt says, that he has seen the enormous vulture of the Andes, the majestic Condor, whose wings, when extended, measure from tip to tip no less than fourteen feet, dart suddenly from the bottom of the deepest valleys, to a considerable height above the summit of Chimborazo, where the barometer must have been lower than ten inches. He frequently observed it soaring at an elevation, six times higher than the clouds in our atmosphere. And it habitually prefers an elevation at which the mercury of the barometer sinks to about sixteen inches. Here then, nature has furnished a flying machine, far surpassing any imitation. I would, therefore, propose that a company be formed in London, to be called, the ROYAL SOUTH AMERICAN CONDOR COMPANY—that the company should have the exclusive privilege of importing Condors for a certain number of years—that the directors of the company should send proper agents

to South America, also approved bird-catchers, to catch, train, and domesticate, if possible, these royal birds; and that premiums shall be awarded to the person who shall (within a limited time), produce the best drawings of a carriage and harness for these feathered steeds. What advantages would not be gained to science by such an invention! Astronomers would be enabled to rise above the clouds to make their observations, and many disputes which agitate the scientific world, would be for ever set at rest. The manner in which rain is formed, would be investigated; meteors of all kinds would be examined; even the aurora borealis might be packed up in a bottle, and submitted to chemical analysis.

I foresee other important advantages which might be realized by this invention, but they are of a political kind, and, scarcely therefore, within the scope of the subjects to which your pages are devoted. I will just, however, *by way of hint*, observe, that it might be the means of introducing a broader line of distinction between the *higher* and *lower* orders of society than we have yet been able, with all our monarchical and aristocratical inventions, to establish.

As things have been hitherto ordered, princes and nobles have been forced to breathe the same air, and tread the same ground, with vulgar clodpoles and "unwashed artificers." (How shocking!) But were the regions of air once placed at our command, it might be decreed that each rank in society should have a certain space assigned to it exclusively. For example:—the highest personage in the state, and all his kith and kin, might have the privilege of ascending to the *highest* elevation, and revelling there in a region exempted from all plebeian pollution. The superior orders of the clergy would, I presume, insist on the next place—some *tenth* proportion or so of the aerial territory, where they might charioteer it over the heads of mere dukes, marquises, and barons, and have only kings and kings' cousins to look up to. The dukes, marquises, and barons, could not be denied, in their turn, a broad space of their own, whence they might *look down with due disdain* on aspiring baronets, aping knights, purse-proud citizens, *et id genus omne*. As for mere common folk, they would, of course, require to rest satisfied with such share as might be left to them, after their betters had been accommodated; but to prevent any crowding in the nether regions of the atmosphere, it would not, perhaps, be amiss to prohibit altogether the use of Condors to every person who could not swear that he possessed a freehold estate of at least forty shillings a year. In Ireland it would be necessary to raise this minimum to *two hundred* shillings; for there, as every body knows, money is so much more plentiful than in England, that your forty shilling people are mere *vermin*, no worth taking into account in any genteely-constructed scale of civil society.

It may be asked, how these different allotments of air could be measured off, and fenced in? Very easily; all that would be necessary would be to attach to each Condor-carriage a barometer, and to give it a license to work only within a certain range of atmospheric pressure.

Trusting, Sir, that whatever takes place, you will long continue your meritorious labours among us (lower orders), is the sincere wish of,

Your very humble servant,

A. MACKINNON.

P.S. I have alluded to the aurora borealis; it is singular that no writer with whom I am acquainted has taken any notice of the sound produced by this beautiful meteor; in fact, they seem to be entire strangers to it. If the author of the new theory, in your seventh volume, had been acquainted with the above fact, it might have been of service to him; for he might then have proved that the sound was produced by the particles of light striking against those of ice.

ON THE THEORY OF THE UNIVERSAL VITALITY OF MATTER.

(Concluded from page 48.)

But to return to the vitality of material elements. Animal and vegetable matter having been interred in the earth, or decomposed upon its surface, for nearly six thousand years, if the parti-

cles were immortal in the animalcular form, the grave would not secure them, and the earth by their accumulation would be heaving and rolling under our feet. There is abundant evidence, however, that bodies continued in the grave long after their inhumation. A single instance is sufficient for the argument. The remains of Charles I. of England were discovered a few years since, after having been interred two hundred years. They were found in their natural state, so far as to be readily identified, and exhibited every appearance of inert matter, resolved and resolving into elementary dust.

The microscopic theorists having conducted us to the lowest gradation of existence, remark that "physiologists can carry analysis no farther, except to convert the substance into gases by distillation." If so, where is the vital principle then? Can distillation extinguish that principle which resisted death and all the previous stages of decomposition? If "life and matter are coexistent, and from everlasting to everlasting," it is absurd to say that distillation, or any other material agency, can separate them, or destroy that life; and there appears no other alternative but to presume it to be still existing invisible among those aerial vapours to which it was driven by this mode of analysis, waiting for some casual chance to be united to a new shape, and enabled to pursue some new career of being.

From these premises the conclusion is irresistible, that after experiencing the changes of death and decomposition, material atoms, possessing inherent vitality, *are transformed into some unknown shape of moving life*, which establishes the doctrine of the metempsychosis without qualification. Those who affirm that when a living being dies, it only changes its form, will easily believe that men may arise unseen from their sepulchres to people the fields and forests;* or, indulging the poetry of feeling, they may fancy their departed friends returning among them as singing birds or blooming flowers, or as waving trees overshadowing their dwellings.†

But our later philosophers are not as courteous as Pythagoras and Ovid, nor as pious as Plato and Epicurus. They make us descend to the most degraded state, and from the decomposing remains of our animal nature they see clouds of loathsome insects floating on the air, winged with pestilence and death. They do not indulge in the fine imaginings of those heathens; the former of whom maintained that the spirits of human beings who led virtuous lives were changed into seraphs, fairies, and heroes; trees, flowers, and fountains: or with the latter, that the gift of life was *bestowed* by a divine almighty power, or with Plato, that it remigrates to the divinity from whence it originated, after leaving its transitory abode in this world.

In assuming that "life and matter are coexistent," identified, indivisible, and eternal, it is also asserted, "that it is perpetually living, dying, reviving, and recombining in new shapes and modes of existence."‡ If so, then is not the boast of the atheist established, and accountability and moral obligation destroyed?

Based upon this hypothesis is the theory of the gordius aquaticus, or horse-hair snake; and as this is the boldest example, in illustration of this system of physiology, it is selected as a test for the

THIRD INQUIRY—*Whether inert particles of matter spring to life in forms and natures remote from, and opposite to, their own previous state of existence?*

It is imagined that myriads of monads congregate upon a hair immersed in water; that having in itself a vital principle, it assimilates with these extraneous visitants, and they with each other, until this admixture of fortuitous materials becomes a living being; that gradually "a complete animal is developed, the root of the hair assuming the shape and character of the head, with eyes and mouth." It is not difficult to conceive that a hair, by being placed in water, an element where millions of ephemera occasionally reside, should be covered with them so as to make an entire surface, and that from its elasticity their motions should impart sinuosity through its whole length, and that it should be found writhing and turning like an organized, animated being, although no more endowed with animal life than the limb of a tree, which sways backward or forward, in compliance with the impulse of a boy upon its branches. But for a mass so heterogeneous, and so far removed from all the habits and laws which are invariable concomitants of animal life in every known instance, to obtain a head to guide its voluntary motions; a mouth

* Pythagoras. † Ovid. ‡ Mason Good.

whereby to receive its sustenance; itself affording aliment to a congeries of insects, creatures of a distinct and separate genus; to become identified with them, and spring to independent existence, and be itself the individual in which they lose their identity—is too monstrous and absurd to admit of belief. It is confounding the distinctions which divide animals from each other, and from brute matter, to affirm, that an integral part of a quadruped, having been reduced to utter inertness, should revivify itself, acquiring a head with its curious and complex organization to control its movements, and from the identity of a land animal to become a water serpent. If it be possible for one quadruped to produce snakes, another may; and, if snakes, why not other and more monstrous forms of existence?

Pursuing the analogy, why are not cemeteries and fields of battle overgrown with night-shade and hellebore, and peopled with gorgons and hydras? But it is argued that a butterfly arising from a worm is analogous to the presumed metamorphosis of the gordius aquaticus. The example is not a parallel one. The butterfly preserves its identity through all its changes; it is the same specific and entire being; and its race is continued subject to the same invariable laws. It is not a casual association of atoms, at one time part of a horse, at another, part of a serpent. If the chrysalis were attached to the side of a piece of tortoise-shell, or other substance similar to hair, and on bursting its cerements, the shell should become its head or its painted wings, then the case would be parallel to the horse-hair snake.

It is farther stated, as will be kept in mind, that vegetables after death arise with the locomotion of animals. Also that the monads of animal remains revive in vegetables, or animals, as chances occur. The atoms of a chesnut leaf were animals while in the water, but upon being dried upon the sides of the glass, became vegetables, with appropriate forms and colours: and finally, that a drop of water in which a vegetable (potato) had been *boiled*, discovered innumerable atoms in great activity. This is an anomaly in the experience of the whole world, boiling heat being destructive of life; but in this instance the vital principle is stated to have triumphed over its vegetable origin—over death—over the destruction of fire—and, surpassing even the fabled Phœnix, *to have* awaked to life and animation.

The examination of this subject has been extended far beyond my original design; but on a review of the whole argument it appears that the following are undeniable positions:—

1st. That life is not inherent in matter, because it is in proof that the material elements of animal and vegetable remains continue insensate for ages after death—that the presumed fact of their revivification rests upon the slender evidence of microscopic observations—that the phenomena adduced to establish it were probably optical illusions, occasioned by chemical action and disturbance—or were owing to some other cause than material innate vitality.

2d. That the order which prevails throughout the visible creation proves that all things are governed by immutable laws, which have been the same from the beginning, and which forbid the revolting idea that inert matter springs to life in odious and degraded shapes, remote from its generic origin; and that animals cannot change to vegetables, nor vegetables to animals; nor animals to others of opposite genera; else

> "Man himself might spring from ocean,
> Prone down the skies the bellowing herds might bound,
> Or from promiscuous earth the finny race and feathery tribes ascend."*

If these inferences are correct, it follows, that in all the complicated series of existence, and in all the changes which chemical and other agents produce upon matter, the hidden principle of life has never been revealed.

Even galvanism, which has almost imposed upon the credulity of science a suspicion that it possesses the power of restoring the vital principle after it has left the clay, has been found to exert only a mechanical action upon the inanimate subject; while it electrifies the muscles and limbs, and produces motion resembling life, yet life is not there, and the hideous distortions it occasions, as if in mockery of human wisdom, leave the body an example of the insufficiency of matter to revivify itself, or to furnish any clue to the mystery of its animation.

Vegetable life is equally hidden from human sight. A grain of sand cannot become a tree, though with other grains and other combinations it sustains the tree in verdure and beauty. If men could obtain a knowledge of the mystery of life, they might restore it when taken away—the fabulous systems of the

* Lucretius.

poets might return as realities—groves might wave in sudden luxuriance over the dreariest deserts—and multitudes arise, as if by the magician's impulse, where solitude and silence have hitherto held undisputed dominion.*

* The author appears not to have adverted to the fact, that innumerable animalculæ are discovered by the microscope in and upon almost every thing, and that therefore the apparent animation of inert matter may arise from the adherence of these animalculæ, whose origin is doubtless by the regular although singular processes of life.—*Note by Professor Silliman.*

AMERICAN FIRES.

New York versus *Philadelphia.*

Sir,—I have made the following extract from Captain Basil Hall's Travels in North America, in the years 1827 and 1828, on account of the striking contrast which the conduct of the citizens of New York offers to that of the more provident Philadelphians, as described at p. 394 of your tenth volume, by your esteemed contributor, Dr. Johns:—

"At two o'clock in the morning of the 20th of May, 1827," says Captain Hall, vol. 1, p. 19, "I was awakened by loud cries of 'Fire! fire!' and started out of bed, half dreaming that we were still at sea, and the packet in flames. In a few minutes, the deep rumbling sound of the engines was heard, mingled in a most alarming way with the cheers of the firemen, the loud rapping of the watchmen at the doors and window-shutters of the sleeping citizens, and various other symptoms of momentous danger, and the necessity of hot haste.

"So much had been said to me of the activity and skill of the New York firemen, that I was anxious to see them in actual operation; and accordingly, having dressed myself quickly, I ran down stairs. Before I reached the outer door, however, the noise had well nigh ceased; the engines were trundling slowly back again, and the people grumbling, not without reason, at having been dragged out of bed to no purpose. Of this number I certainly was one, but more from what I had lost seeing than from any other cause.

"I was scarcely well asleep again, before a second and far more furious alarm brought all the world to the windows. The church bells were clanging violently on all hands, and the ear could readily catch, every now and then, a fresh sound chiming in with the uproar with much musical discord, and all speaking in tones of such vehemence, as satisfied me that now there would be no disappointment. On opening the street-door, I saw in the east, a tall column of black smoke, curling and writhing across the cold morning sky, like a great snake attempting to catch the moon, which, in her last quarter, was moving quietly along, as if careless of the increasing tumult which was fast spreading over the city. On the top of the city hall, one of the finest of the numerous public buildings which adorn New York, a fire-warden or watchman is constantly stationed, whose duty, when the alarm is given, is to hoist a lantern at the extremity of a long arm attached to the steeple, and to direct it towards the fire, as a sort of beacon, to instruct the engines what course to steer. There was something singularly striking in this contrivance, which looked as if a great giant, with a blood-red finger, had been posted in the midst of the city to warn the citizens of their danger. I succeeded, by quick running, in getting abreast of a fire-engine; but although it was a very ponderous affair, it was dragged along so smartly by its crew of some six-and-twenty men, aided by a whole legion of boys, all bawling as loud as they could, that I found it difficult to keep up with them. On reaching the focus of attraction, the crowd of curious persons like myself began to thicken, while the engines came dashing in amongst us from every avenue, in the most gallant and business-like style.

"Four houses, built entirely of wood, were on fire from top to bottom, and sending up a flame that would have defied a thousand engines. But nothing could exceed the dauntless spirit with which the attempt was made. In the midst of a prodigious

noise and confusion, the engines were placed along the streets in a line, at the distance of about two hundred feet from one another, and reaching to the bank of the East River, as that inland sea is called which lies between Long Island and the main. The suction-hose of the last engine in the line, or that next the stream, being plunged into the river, the water was drawn up, and then forced along a leathern hose or pipe to the next engine, and so on, till at the tenth link of this curious chain it came within range of the fire. As more engines arrived, they were marshalled by the superintendent into a new string; and in about five minutes after the first stream of water had been brought to bear on the flames, another was sucked along in like manner, and found its way, leap by leap, to the seat of the mischief. I moved about among the blazing houses till driven back by the police, who laboured hard to clear the ground for the firemen alone. On retiring reluctantly from this interesting scene, I caught a glimpse of a third jet of water playing away upon the back part of the fire; and on going round to that quarter, discovered that these energetic people had formed a third series, consisting of seven engines, reaching to a different bend of the river, down some alley, not quite so far off.

"The chief things to find fault with on this occasion were the needless shouts and other uproarious noises, which obviously helped to exhaust the men at the engines, and the needless forwardness, or it may be called foolhardiness, with which they entered houses on fire, or climbed upon them by means of ladders, when it must have been apparent to the least skilful person that their exertions were utterly hopeless. A small amount of discipline, of which, by the way, there was not a particle, might have corrected the noise; and the other evil, I think, might have been removed by a machine recently invented in Edinburgh, and found to be efficacious on like occasions."

The machine here alluded to is the Triangle for elevating the jets of fire-engines, described at page 169 of your sixth volume. The worthy captain was at great pains to explain the construction and use of this machine to the citizens of New York; but I *guess*, that while they reckon it not worth while to provide a proper supply of water in the first place, it will be useless to calculate upon their adoption of any improvements of a secondary description like the present. When we consider the great frequency of fires in New York, surrounded as it is with such an abundance of water, it appears almost incredible that no water-works should have been erected for the supply of that important article, especially as this has been done in so efficient a manner in Philadelphia. This is, however, but *one* instance, out of many thousand, of the apathy and indifference of some classes of men, and their tardiness to avail themselves of the improvements of their neighbours, and of the age in which they live.

I am, Sir,
Respectfully your's,
W. BADDELEY.

ON THE SIGHT OF THE MOLE.

[*Translated from the Annales des Sciences d'Observation.*]

Does the mole see? Aristotle and all the Greek philosophers believed it was blind. Galen, on the contrary, maintained that it sees; he affirmed that it has all the known means of vision. In more recent times, the question was revived, and naturalists ascertained that the animal has an eye, though one of extremely small dimensions, being scarcely larger than a grain of millet. But, strange to say, though they found out an eye, they could not discover an optic nerve. Now what purpose could an eye serve, which is deprived of the nerve, which in other animals transmits the visual sensations to the brain? This consideration naturally carried philosophers back to the opinion of Aristotle and the Greeks; and led them to believe, that in spite of its eye, the mole does not see, and that, what, for courtesy sake, was called an eye, is nothing but a rudimental point without any use, like

the nipple in man. Later experiments, however, instituted by M. Geoffrey St. Hilaire, have demonstrated in a most incontestible manner, that the mole does make use of its eyes, sees obstacles when placed in its way, and turns aside to avoid them. If then the mole sees, is it possible that it has no optic nerve? M. Serres thought that the place of this nerve was supplied by a superior branch of the fifth pair of nerves, analogous to the opthalmic branch of Willis. But M. Geoffrey St. Hilaire has shewn, that this transference to a nerve of a function which does not naturally belong to it, has no existence in fact, and that the mole not only sees, but, as Galen said, is provided, like other seeing animals, with two ocular nerves, a principal and an accessory one, that is to say, the optic and opthalmic nerves.

FLATNESS OF THE SOLES OF THE FEET.

(From Marshall's Hints to Young Medical Officers.)

When the plantar arch is well formed, we stand on the heel (os calcis) and the distal extremities of the metatarsal bones. The concave shape of a well-formed foot is an admirable provision for defending the nerves and blood-vessels, that ramify under the middle of the foot, the use of which is painfully demonstrated to us when we ascend a ladder with narrow steps, or tread upon a pointed body.

In splay-footed persons, where the sole is not merely flat, but in some degree convex, the tendons of the sole are elongated, accompanied with a subsidence of the bony arch, both in regard to the length and breadth of the foot, by which means the tarsus becomes the broadest part. The os naviculare projects, thereby producing a convexity of the inside of the foot; the inner ankle nearly approaches the ground, and in a number of instances the internal malleolus projects much more than is natural. In some cases the limb is oblique, and the muscles on the back of the leg are commonly but little developed. Very long as well as flat feet commonly have a tendency outwards, seemingly to make up for their inability to grasp the ground by extending the base of support.

In the mechanism of walking, our feet become levers of the second order, which may be compared to the action of an oar in rowing a boat, the weight being situated between the power and the fulcrum. When the sole is convex (splay-footed) the fulcrum is, during progression, less distant from the power than in a well-arched foot, consequently the influence of the lever is proportionately diminished, and the natural spring of the foot impaired. The effect may be compared to that of rowing with a short instead of a long oar. In consequence of the weight of the body falling upon the centre of the sole, instead of the heel and the anterior extremities of the metatarsal bones, the play of the ankle joint and the other joints of the foot is nearly lost, on which account the other joints of the body are comparatively little used; hence almost all splay-footed persons carry the head and shoulders, as also the elbows, backwards, while the spine at the loins is commonly pushed forward. They move their feet smoothly along the ground (*skoofing* Scottice), with a general stiffness of the body, as if they were pushing a wheelbarrow before them. Let any person place a body under the arch of the foot, and try to walk with a stiff ankle, and he will easily comprehend the above description.

Splay-footed individuals are unable to endure easily the fatigue consequent on long marches; more labour being required from them to produce a certain effect than from persons whose feet are well arched. In another respect they are disqualified for military service, on account of the lateral vacillations they make in walking. When a foot is well formed, the heel is first raised from the ground, and the body rests for the time on the fore-part of the foot and toes. But when the sole is convex, the extremity partakes in some degree of the inaptitude of a wooden leg; and, owing to the inelasticity of the foot and the stiffness of the ankle joint, the

body at each step describes a portion of a circle. In file marching, the irregular undulations of a man with deformed feet are liable to throw the rear of a line out of its proper direction.

The flattened state of the arch of the foot occurs in every possible degree; hence there are many shades of the deformity which do not disqualify a man for the service. In the examination of recruits due attention should be paid to distinguish these varieties, and particularly to avoid confounding uncommonly broad though tolerably well arched feet with those in which the soles are convex and the limbs oblique.

Flatness of the soles of the feet appears to be a congenital deformity, and prevails in particular families and races of people. Many tribes of Africans have generally flat feet with remarkably long heels. I have met with instances of another kind, where the instep was very high, the plantar arch being remarkably acute, so much so, that the middle of the foot did not nearly approach the ground: this defect, which in some instances is a serious one, is the *pied-equin* of the French anatomists.

LUSUS NATURÆ.

The Boston Patriot gives the following account of a very singular *lusus naturæ*.— "The Sachem, which arrived at this port yesterday, (Aug. 20), has on board two Siamese youths (males), eighteen years of age, whose bodies have been connected from their birth. They appear to be in good health and apparently contented with their condition. They are about five feet in height, well-proportioned, strong and active, good-natured, and withal, intelligent and sensible. A substance, apparently bony or cartilaginous, about seven inches in circumference, and four in length, proceeding from the umbilical region of each, unites them firmly together. They run about the deck and cabin of the ship with the same facility that any two healthy *lads would do, with their* arms over each other's shoulders, this being the position in which they move about."

NATIVE PLATINA.

Before the return of Humboldt from America, the largest specimens of native platina in the mineralogical cabinets of Europe scarcely exceeded the twelfth of an inch in diameter. Humboldt brought one over with him which weighed 1,088 grains, and this continued to be the largest known till 1822, when the Museum of Madrid was enriched with a specimen, obtained in the course of the gold washings of Condoto, which is $2\frac{4}{10}$ inches in diameter, and weighs 11,641 grains. But both these specimens have been eclipsed by one found in the Demidoff Mines of the Oural Mountains, which weighs 4·320 kilog. (about 9 pounds), and is of a density a little under 16.

M. Humboldt has lately announced that he is engaged on a work which will be an important contribution to the history of this interesting mineral. It is a Map of the Province of Choco, in which he will point out all the localities where platina has been or is likely to be found.

ON THE EFFECTS OF HIGH TEMPERATURES WHEN APPLIED TO THE EVAPORATION OF LIQUIDS.

The following are the results of a series of experiments recently made in Paris, by M. Longchamp, and reported to the Academy of Sciences:—

1. That at high temperatures the evaporation is not in proportion to the heated surfaces as in ordinary cases, but rather in proportion to the capacities exposed to the heat. For example:—A tube of three-twelfths of an inch in diameter, and 8 inches long, which dimensions give a capacity of 0·375 cubic inch, has evaporated a kilogramme (2 lbs. 3 oz. 5 dr.) weight of water in 24 hours, while in a tube of 2 inches diameter, and 32 inches long, 500 kilogrammes were evaporated in the same time. Now, the first capacity is to the second as 6 to 1,536, which is precisely the propor-

tion which the qualities evaporated bear to each other.

2. That the evaporation which takes place when the evaporating vessel is made red-hot, is eight times greater in a given capacity than it is at the temperature commonly applied to steam-boilers.

INQUIRY.

Sir,—Being desirous of constructing a fountain on a small scale (in a garden) I shall feel obliged by any of your correspondents informing me of the best method of doing so, through the "Mechanic's Magazine."

I am, Sir,
Your obedient servant,
S. H.

MISCELLANEOUS.

Tepid Bathing.—It is a curious anomaly in English habits, that tepid bathing should be so much neglected among a people proverbial, in other respects, for their cleanliness. In Paris there are upwards of 150 public baths besides establishments for portable ones, which are in great request, and supplied at a very reasonable rate; whereas in London very few public baths exist, and only one or two portable baths. This neglect is the more surprising, considering that there is nothing so well calculated as tepid bathing to prevent those inflammatory diseases peculiar to this variable climate. In many cases the surface of the body is chilled for some hours before the attack of external or internal inflammation—the continuance of chilliness being in fact the cause of inflammation, by disordering the circulation of the blood. But were the circulation equalized at the commencement of the chilliness, by a warm bath, it would generally prevent the occurrence of any acute affection of an inflammatory nature. Z.

Dye from Potato Flowers.—Sir John Sinclair has been recently engaged in a series of experiments, by which he has ascertained that permanent and beautiful colours in silk, cotton, and woollen goods, may be obtained from the flower of the potato. Sir John says these colours are equal to the finest tints procured from the most valuable foreign materials, and in richness of shade are likely, in some cases, to be even superior. "It is a peculiar advantage," he adds, "attending this discovery, that the cutting of the flowers of the potato is not prejudicial to the plant; on the contrary, by preventing the formation of the seed or apple, there is reason to believe that it will add to the weight and improve the quality of the root."

Fuel for Steam-Vessels.—A Mr. G. B. White, of Brooklyn, New York, has contrived a compound which he calls "concentrated fuel," for the use of steam-vessels, which is said to burn as well as pine, and to occupy about one-third of the space required for wood.*e*

A Canine Artillerist.—Mustapha, a strong and active dog, belonging to an artillerist of Dublin, raised from its birth in the midst of camps, always accompanied its master, and exhibited no alarm in the midst of battle. In the hottest engagements it remained near the cannon, and carried the match in its mouth. At the memorable battle of Fontenoy, when we broke the square battalions of the Hanoverians, the master of Mustapha received a mortal wound. At the moment when about to fire upon the enemy, he and several of his corps were struck to the earth by the discharge of artillery. Seeing his master extended lifeless and bleeding, the dog became desperate, and howled piteously. Just at that time a body of French soldiers were advancing rapidly to gain possession of the piece, which was aimed at them from the top of a small rising ground. Who would believe it, if the fact were not attested by several witnesses worthy of credit? Doubtless with a view to revenge his master's death, Mustapha seized the lighted match with his paws, and set fire to the cannon loaded with case-shot: 70 men fell on the spot, and the remainder took to flight. After this bold stroke the dog laid itself down near the dead body of his master, licked his wounds, and remained there 24 hours without sustenance. He was at length with difficulty taken away by the comrades of the deceased. The courageous animal was carried to London, and presented to George II., who had him taken care of as a brave servant.—*Histoire des Chiens Celebres.*

Small Money.—The silver penny was the lowest English coin in use until the reign of Edward I. Neither halfpence nor farthings were known among the Anglo-Saxon monarchs, with the single exception of Edward the Elder. Silver farthings were introduced at a comparatively late date, and continued to be coined as long as the increased value of that metal would permit; but at length their size was of necessity so much diminished, that the making of them totally ceased in the reign of Edward VI. To supply the place of these, James I. afterwards caused farthing tokens of brass and copper to be made, but at a value so much inferior to the rate at which they were issued, that they were never recognized as legitimate coins, and soon sunk into disuse. The first real copper money was coined by Charles II. in 1665. It was not, however, then made current; and the commencement of a regular coinage of that metal, is not to be dated before 1672.

Signs of Winter.—The Swallow has been already observed taking its departure for warmer regions. The time of its leaving this country varies in different seasons; it is sometimes protracted till the end of October or the beginning of November, and Swallows have been seen to congregate previously to taking their departure as late as the middle of December. A great diversity of opinion has existed respecting the torpidity and migration of this bird: but it seems an established fact, that, although the greater part of the Swallows that visit England quit the country before the approach of winter, many remain and continue in a state of torpidity till the enlivening sun of April wakes them from their long sleep.

Sept. 12. A. R. GANSHILL.

Progress of Knowledge.—Polydore Virgil, who wrote in the time of Henry VIII., was so alarmed at the growing propensity to encourage navigation which then appeared, from the insuperable dangers which he thought must attend it, and the folly of ever bringing it to perfection, that he compared the rashness of mankind in exposing themselves to the mercy of the waves, upon a few frail planks of wood, to the attempt of Dædalus himself, and says that "we not only plough the sea, but inhabit it; that driven by the violent lust of gain, we build ships as large as houses; that every nation hath the boldness to contend for the sovereignty of the sea, and to fight battles upon it, like those upon dry land."

Enormous Blast.—It is stated in an American paper, that in the progress of cutting the Delaware Canal, four kegs of gunpowder, containing about 100lbs., were lately used for a single blast, and had the effect of rending in pieces more than 400 cubic yards of rock. "This," it is added, "is the largest blast ever made in the United States."

Alchemists.—Anthony Wood gives a curious account of the adventures of two noted alchemists, Edward Kelly, an Oxford student, and Dr. John Dee. Kelly had both his ears cut off for one of his exploits in Lancashire. He had, in order to know something concerning the death of a young gentleman, invoked some infernal spirits in the park of Walton in the Dale, Lancashire, and afterwards took up the body of a man buried in Law church-yard, which body he caused, by his incantations, to utter strange predictions. Notwithstanding the loss of his ears, which were not as long as those of his customers, Dee employed him as his *Skryer* (to report the words of the spirits.) They went abroad, together with Laski, a Polish nobleman, in the year 1583, and residing chiefly in Bohemia, continued their incantations for some time, but quarrelling at last about the division of the spoil, Dee returned to England. Kelly was knighted by the Emperor Rodolph the Second, who spent much of his time in search of the philosopher's stone. Kelly amused him for some time, but his tricks being discovered, he was ordered into custody. In this dilemma his old friend the devil left him in the lurch, for, endeavouring to escape from a high window, he broke his leg, and died soon after. Lord Willoughby, Queen Elizabeth's ambassador at Prague, sent an old warming-pan to her Majesty, part of which had been transmuted into gold by Kelly. The Queen, it seems, was so perfectly convinced of the truth of the story, that she sent Peter Gwynne to Bohemia to persuade Kelly to return to England.

The Hanging Gardens of Limerick, in Ireland, are a great curiosity. An acre of ground is covered with arches of various heights; the highest forty feet and the lowest twenty-five; over these arches is placed a layer of earth of five feet thick, and planted with choice fruit trees and flowers. The arches are employed as cellars for spirituous liquors, and will hold nearly 2,000 hogsheads. The work was commenced in 1808, and was completed in about five or six years. The expense of the whole undertaking was nearly £15,000.

The celebrated Mankeim Telescope, the masterpiece of the famous Speiger, a Hungarian optician, was destroyed in a singular manner. A servant of the observatory having taken out the glasses to clean them, put them in again, without observing that a cat had crept into the tube. At night, the animal being alarmed at the strong power of the lunar rays, endeavoured to escape: but the effort threw down the instrument, which, falling to the ground, from the top of the tower, was broken to pieces.

NEW PATENTS.

William Shand, of the Burn, Kincardineshire, for improvements in distillation. 10th of August. 6 months.

John Macleod, Esq., of Westminster, for improvements in preparing barilla. 10th of August. 2 months.

James Rowland and Charles M'Millan, of Spitalfields, Middlesex, for an improved mode of constructing street-ways, &c. 11th of August. *6 months.*

Edward Weeks, of King's-road, Chelsea, for improvements in raising fluids. 14th of August. 6 months.

Henry C. Price and Charles F. Price, of Bristol, for an improvement in apparatus for communicating heat. 20th of August. 6 months.

John Mushet, of York-square, Regent's-park, for a certain medicine for gouty affections of the stomach, spasms, &c. 20th of August. 2 months.

John Jones, of Leeds, for improvements in machinery for dressing woollen cloths. 21st of August. 6 months.

William Roger, of Norfolk-street, London, for certain improvements in the construction of anchors. 21st of August. 6 months.

MINOR CORRESPONDENCE.

"A Constant Reader" recommends the external use of the oil of walnuts, as a safe and efficacious remedy for cutaneous eruptions. The oil is obtained by absorption (as the oil of almonds.) It is imported from France and Germany, where its qualities are properly appreciated. The newer the oil, the more speedy and effectual will be the cure. The present is a most abundant year for the fruit.

Sir,—I read with pleasure your excellent Magazine of Saturday, the 12th inst; and beg to observe, that nothing is easier than to supply the want alluded to in Mr. Baddeley's article on the waste of water in case of fires. Imagine that a cubical foot of metal is excavated with a chisel to the depth of 9 inches, leaving 1½ inch on the sides of the edges; then cut ½ inch one inch deep; the upper edging will be ½ inch broad, and the lower part will support a metal cover, which if slightly convex, would support the heaviest waggons that might pass over it. By lifting the cover, the ends of suction-pipes could be inserted without any disturbance to the pavement.

I am, your's truly,

HUGH.

Sept. 13, 1829.

INTERIM NOTICES.

Another valuable present to practical men.—In our next Number we shall publish a description, with an engraving, of an Improved Sliding Rule, or Mechanical Ready Reckoner, invented by Mr. Saddington; by means of which all questions in arithmetic relating to money may be solved by a single operation in the three different denominations of pounds, shillings, and pence.

The communications which we have in hand from Mr. Saul are all intended for insertion. When articles require engravings to illustrate them, we cannot always give them as early a place as they would otherwise obtain.

Mr. Sinclair's Demonstration of his Mode of finding the Longitude, and Mr. Peacock's Remarks on that Mode, we are obliged, for want of room, to postpone till next week.

Communications received from J. O. B.—Mr. Baddeley—Henry D.—J. O.—Z.—S. P. W.—Mr. Taylor—Arithmeticus—F. F.—Mr. Prentis—Y. E. Y.—A Friend at Manchester.

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"Perhaps there is no single term which can be applied with strict propriety, to designate what has, in so eminent a degree, dispelled the gloom of ignorance, and lessened the tyranny of superstition (on which some of the heaviest curses of mankind have hung,) but if there be one, it is the word SCIENCE. science is the basis of philosophy; philosophy embraces all knowledge; knowledge is the most sure means of happiness; and happiness is the end and object of man's creation."

MR. J. GWILT'S DESIGN FOR A NEW LONDON BRIDGE.

Fig. 1.

Fig. 2.

DESCRIPTIVE ACCOUNT OF THE BRIDGES OVER THE THAMES, BY MR. C. DAVY.

No. 3.

OLD LONDON BRIDGE.

Proposals for a New Bridge, &c.— Gwilt's design.

A committee having been appointed in 1746, for the purpose of considering and adopting means for the "Improvement of the Port of London," a series of questions were drawn up by them and submitted to George Dance, Esq.* for his answers thereto. Many facts of an important nature were elicited from that eminent architect, and a few of these I shall notice.

The construction of the old bridge, for a work of that magnitude, is exceedingly defective. In common with most ancient structures of that description, it is erected upon *stilts*, a species of piles driven into the bed of the river, and upon which are raised the piers. These stilts are surrounded, at a short distance, by other rows of piles, forming the starlings—those unsightly and inconvenient portions of the present structure. The space thus enclosed by this description of dam, was filled in with chalk, stones, and loose rubbish. The piles being sawn off at the level of low-water mark, the piers, as before stated, were then carried up. It will be at once seen that this mode of building is subject to many and strong objections. In the first place, it became necessary to wait for the lowest level, for the purpose of continuing the work, a circumstance in the building which may probably account for the bridge having occupied thirty-three years. The thrust of the arch has besides a tendency to overturn the piles, which of themselves, and to add to the danger, consist wholly of loose rubble work, cased with an ashlaring of stone. The water-way too, is so much contracted by the extent of the starlings, that a consequent rise of water takes place under the arches; and this, added to the natural fall in the bed of the river, taught the expediency of using what are technically termed *drip shot piles*, and driving the same into the bed of the river, (under the arches) to prevent the water from galling or wearing it away. This, although absolutely necessary, again contracted the extent of the water-way, and according to the observations of Labelye, made in 1746,† this additional obstruction amounted to one-sixth of the measured width, or in the whole extent to 39½ feet, making out of 900, or 926 feet, only 196½ feet of water-way.‡ According to the most accurate observations that have been made, the fall of water caused from the obstructions herein mentioned, is about 4 feet 9 inches. From the answers of Mr. Dance to the interrogatories put to him respecting the depth of the first course of stones or footings to the piers, it appears that they are of various depths, and it seems highly probable, considering the loose and unconnected nature of their materials, that the piers have at different times settled considerably. The footings to the foundations of the piers extended 7 inches on each side of the body of the piers, and the first course of these stones was placed, some at 5 feet, and others at 4 feet, 1 foot, and 2 feet, &c., some above, and others below low-water mark. The piles, Mr. Dance states, were rough, round, and unhewn, driven close, shod with iron, and were not connected together by capciles, but in some instances were planked.§ The timber mostly employed for the latter was of oak; the piles chiefly of elm, and 1 foot in diameter.

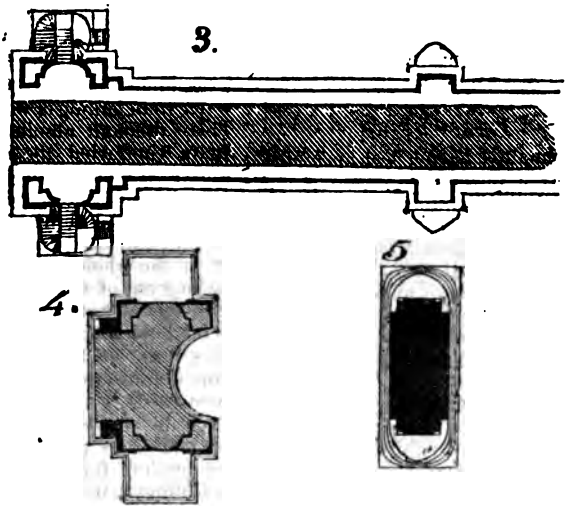
Such was the construction of Old London Bridge, an extraordinary specimen of the *wisdom* of our ancestors in bridge buildings, and erected at a time when old English architecture was in other edifices rapidly advancing to that perfection which has ever since called forth the admiration of scientific and practical men. The examination of this structure in 1746, gave rise to great and expensive reparations, but

* Surveyor-General of the City of London. It is proper to mention that the questions were open to any architect or engineer, for the purpose of replying *to the same.*

† See Hutton's Tracts, No. 1.

‡ Philos. Mag. vol. 3, 1700.

§ Supposed to have been added at the time of making repairs.



not till after the lapse of a considerable period. They were made under the direction of a committee, and cost upwards of £80,000. Notwithstanding this immense expenditure, the bridge still continued subject to great decay, and occupied the attention of committees and sub-committees till the year 1800, when certain voluminous reports appeared under the authority of parliament, intituled, "Reports from the select committee upon the improvement of the Port of London." These reports exhibited the result of the labours of Messrs. Telford and Douglass, Dodd and others, to facilitate the access of shipping between Blackfriar's and London bridges. The project of Messrs. Telford and Douglas for this purpose, attracted much attention for its boldness. They proposed to build a bridge about 300 yards from the present old bridge, so as to make the approaches to range with the Royal Exchange, and the High-street of the Borough, and this bridge was to have been of iron, the arch, (a segment of a circle) 600 feet span, the versed sine from above high water 65 feet, roadway 45, enlarging to 90 feet at each extremity. The ornamental details were to have been in the Gothic style. The drawings, &c., with certain queries, were submitted to *Dr. Hutton, of the Military Academy at Woolwich*, who in his answers gave his full approbation of the design.* Nothing however was done towards carrying it into effect, and with the exception of further temporary repairs to the old bridge, things remained in the same state till 1820.

In this year numerous petitions were presented from parties interested in the improvement of the navigation of the Thames, and a special committee of the House of Commons was appointed, which, after hearing witnesses, and examining other evidence, made a report strongly advising the erection of a *new bridge*. After much delay the corporation, in June 1822, offered premiums of £250, £150, and £100, for the three best designs for the rebuilding of the bridge. This notification produced no less than 48 designs, which were referred to Messrs. Nash, Soane, and Smirke, the three architects of His Majesty's Board of Works, and the City Surveyor, who agreed in recommending the one designed by Mr. Joseph Gwilt, (an engraving of which is prefixed to this communication,) as the best. The Court of Common Council, however, refused to confirm the award of their own referees. "Such conduct," says Mr. J. Gwilt, in his preface to his work, *On the Equilibrium of Arches*, 2nd

* Hutton's Tracts, No. 5.

edit. "to a young artist, might have been ruinous, and it was fortunate for the author that his dependence was not on such patrons. The sapient body in question, have, however, been since that time sufficiently chastised for their mismanagement, by a committee of the House of Commons, which wisely took from them all controul over the rebuilding of the bridge, and placed it in more independent hands." The apology the court gave for their conduct was very unsatisfactory. As a clever writer observes,* "they gravely recommended that the choice should remain with them, (the court) being alarmed lest the proposed referees should be partial, because themselves or their clerks, or friends, *may* be amongst the competing candidates. Is it not equally absurd to suppose that that court should have had sufficient knowledge to choose for themselves in such an important matter?"

The design in question needs little explanation. In the first place the extreme elegance of its elevation fully justifies the meed of approbation so flatteringly bestowed upon it by the referees; and secondly, the practical abilities of Mr. J. Gwilt are so well known, that his competency to conduct so great a work could not with any justice be called in question.

The most ancient bridge in existence, whose arch is the segment of a circle, is the celebrated Rialto at Venice, erected in the 16th century, after a design by Michael Angelo de Beaunorotti. This bridge, however, had but one arch of 100 feet span, and a versed sine of 23 feet. Mr. J. Gwilt's bridge was to have five arches, and all of them much larger than that of the Rialto. There is one reason why the elliptical form would have been better adapted for the purpose; but of this I shall treat hereafter; for the present I shall conclude by giving the particular dimensions of Mr. J. Gwilt's design.*

* Palladio's 2nd Letter to John Soane, Esq. note A.

* Mr. George Gwilt, of Union-street (the elder brother of Mr. Joseph Gwilt), the restorer of Bow Church, and of part of that much-neglected edifice, St. Saviour's, Southwark, also designed a plan for a new London Bridge, which plan was submitted to the Committee of the House of Commons, and was acknowledged by impartial members of the profession to be worthy of the head of a highly talented family. The treatment of this plan, and also of that prepared by Mr. Savage, was such as might afford ground for debate whether ignorance or a spirit of jobbery has exercised the most pernicious influence over this public work.—ED.

Centre arch span, 150 feet.
Side arches respectively, 140 and 130 feet.
Number of arches, 5.

Versed Sines.

Centre arch, 25 feet.
Side arches respectively, 23 ft. 4 in., and 22 ft. 8 in. } From high water.
Cut-waters, 25 feet in thickness.
Piles, 20 feet in thickness.
Inclination of carriage-way, 1 foot in 26.
Key-stone, centre arch, 6 feet deep.
Bridge 50 feet in width between the parapets.

References to the Engravings.

Fig. 1. Elevation A. B. high and low water marks.
2. Ditto of abutments and stairs.
3. Plan of superstructure.
4. Ditto of foundations for the abutments and stairs.
5. Ditto of piers.

Note.—The plans are drawn to half the scale of the elevation.

(To be continued.)

GLASS'S FIRE-ESCAPE.

Sir,—Having some months ago taken notice in your useful and instructive periodical work, of a very *ingenious and simple* machine for the *sweeping of chimneys*, invented by Mr. Joseph Glass, and which has been very successfully and extensively applied since that period, I am induced to transmit to you the description of an apparatus for the preservation of life from fire, forwarded lately to me

by Mr. Glass, and which you are at liberty to lay before the public, should you consider it worthy of insertion in your Magazine.

The advantages which the inventor considers his apparatus to possess over the numerous inventions, already brought into notice, are its extreme simplicity, and the ease with which it may be promptly and expeditiously applied in case of fire; and as far as I can judge by seeing its application experimentally tried, I think he is quite justified in his opinion. A common pulley, into one side of which a small iron staple is driven, being procured, a chain 18 inches long is attached to the top, to the other extremity of which is fixed, (if the term be admissable) a comprehensive grappling iron. A strong line is passed through the pulley and made fast to the moveable iron handle,* of a sort of cradle or box, constructed by a wooden frame, round which a coarse canvas is tightly secured; the size of this cradle is 4 feet deep, 2 feet wide, and 2 feet 2 inches broad; the front side being 18 inches lower than the three others, so that when it is drawn up to the sill of a window by the means hereafter described, a person may step into it without any fear of falling on either side; a seat is also provided, which answers the purpose of a step in getting in or out. In cases of emergency the box is sufficiently large to contain two persons.

This is all common-place enough, but it is to the means of raising this apparatus to a window or parapet, that I wish attention to be called, and which, in fact, are borrowed from the principle of the chimney-sweeping machine, described in 243rd Number, for 12th April, 1829, of your Magazine. A number of stout ash sticks, 1 to 2 inches in diameter, are cut in lengths of about six feet, and furnished at each end with strong brass screws. A double prong is fixed to a small piece of cane, also provided with a screw, which fits exactly to any of the ash rods. To hoist the pulley already described to its destination, this hook or prong is passed through the small staple, and the ash rods are then joined in succession, till the elevation required is obtained. The pulley being raised about 2 feet above the window sill, the grappling iron which hangs by the chain, is thrown over, and immediately attaches securely without any assistance from above. The box is then drawn up, and the person waiting to descend, having stepped in, it is lowered and drawn into the middle or opposite side of the street by a guide rope affixed for the purpose.

The whole of this apparatus may be confined in a space of little more than two feet square, and for a ready mode of conveyance from place to place, it is so arranged, as to admit of being carried in the manner of a sedan-chair, by making use of two of the ash rods.

Independently of the box and tackle, a rope-ladder, with a grappling iron at one end, has been constructed, the steps being formed of solid cane one inch in diameter, which combines two very important qualities, lightness and strength. This ladder can be fastened in the same manner as the pulley, and might frequently be found very useful, both for the purpose of ascent to secure property, or as an assistance to those, whose agitation and distress might paralyse their own exertions.

The whole cost of the fire-escape, with the rods, tackle and box, 60 feet, is £4.; with the rods and ladder, £3. 5s.; cheapness therefore would also be one of the principal recommendations of this apparatus.

I am, your's, &c.

W.

* Something like the handle of a common pail, *but of course* considerably larger.

SIZE OF CARRIAGE WHEELS.

Sir,—I will thank you to insert a few observations on the solution of the mechanical problem proposed at p. 304, and answered at p. 439 of the 11th volume of your excellent Magazine.

Both of your correspondents ground their solutions on the 5th corollary to the 20th proposition of Whewell's Mechanics, by which the direction of the line of traction is determined, as

that a *given* wheel may be drawn over a given obstacle with the least possible power, and their solutions therefore, merely determine the radius of a wheel, such that (under the given restrictions) the line of traction will be at right angles to CO (see figure to Mr. Hogan's solution, p. 439, vol. 11.) when the application of the power for that particular wheel will be most advantageous. The question then arises, is it demonstrated that a wheel whose radius (2 feet) answers the conditions of their equation (and in which case the power has been proved to be applied in the best direction possible) would require a less force to draw it over the obstacle, than one of a greater radius? And is it not a question, which their demonstration does not preclude, whether on the whole, power would not be gained by increasing CO, because, at the same time that the power is less advantageously applied (the ∠ACO decreasing) the load or resistance acts also at a disadvantage, which may be either more or less than sufficient to compensate for the decrease of power.

To explain myself further, let the load be considered as suspended from the centre of the wheel, and the power and resistance will be applied at C (the extremity of a lever CO, CB being the fulcrum) in the directions CE, CA, and we will also suppose that ∠ECO is not a right angle—from O draw OX perpendicular to CE*. Then, by mechanics, there will be an equilibrium, when P : W = PO :: XO; now, within certain limits, it will be found that if we augment CA, PO decreases with respect to CO faster than XO does, of course the ratio of XO to PO increases, and less power will be required to sustain the load. Manifestly, therefore, the problem consists in determining CO, such that $\frac{XO}{PO}$ may be a maximum, and this or any thing equivalent, I do not think your talented correspondents have done.

By way of an example, let the weight of the load be 100lbs., and CO=2 feet, then BO=$\frac{1}{16}$=·0625—PO=·348 and CO (=XO)=1·000, wherefore W:P = 1·000 :: ·348 = 100lbs.::34·8lbs.—the power required to sustain the load of 100lbs. Now let CO=4 feet, then BO=$\frac{1}{32}$=·03125, XO=·968, PO=·247, then W:P=·968::·247=100lbs.::25·5lbs. so that, if the line of traction, be horizontal, a power of nearly $\frac{1}{4}$th less than in the former case is sufficient.—In the same manner, when the radi are 7 and 8 feet,

$$W :: P = \left\{\begin{matrix} \cdot 840 :: \cdot 188 \\ \cdot 764 :: \cdot 176 \end{matrix}\right\} :: 100 :: \left\{\begin{matrix} \text{22·3lbs.} \\ \text{23·0lbs.} \end{matrix}\right.$$

Hence, if the radius is 7 feet, the ratio of XO to PO is a maximum, and two-thirds of the first-mentioned power is equivalent to the load.

I should not think that any inference of practical utility can be drawn from the solution of the problem, not only because when a wheel is large, the weight and friction is *very* considerable; but, because the direction in which the power of a horse is applied, in drawing a carriage, should be taken into consideration. A horse draws horizontally, by *pushing obliquely upwards*; on this account, I should conceive, that if the traces incline downwards from the wheel, such direction would be bad in proportion *o* the inclination.

I will just remark that 2 feet (or any number under 4 feet) will not exactly answer the conditions of their equations. The first number that will, is between 6 and 7 feet, in which case the obstacle is to be understood, as placed on the opposite side of the wheel, and the power to be applied by pushing.

To avoid interruption, I assumed that when CO=2 feet, DE would be 4 feet; but, as DE is 4·78 feet, the result 34·8 lbs. is given a little less than *it should be*; and this rectified would make the power saved still greater.

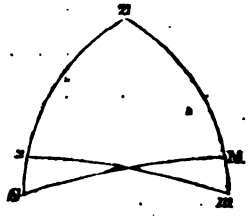
I am, Sir, your's, &c.

R. C. Jun.

* This line may be easily supplied by the reader.

DEMONSTRATION OF MR. SINCLAIR'S NEW METHOD OF FINDING THE LONGITUDE AT SEA.

(*See No.* 315.)



In the above diagram,
Let Z*m*, Z*s*=appt. Zenith distances.
ZM, ZS=true Zenith distances.
hence SM=true distance, *wanted*.

N.V.S.(ZS+ZM)—N.V.S.(ZS—ZM):R²::N.V.S.SM—N.V.S. (ZS—ZM)
:N. V. S.∠Z. and N.V. S. (*Zs*+*Zm*—)N. V. S. (*Zs*—*Zm*):R²
::N.V.S. *Sm*—N. V. S. (*Zs*—*Zm*):N. V. S. ∠Z. } Per Spherics.

And N.V.S.(ZS+ZM)—N.V.S.(ZS—ZM):N.V.S.(*Zs*+*Zm*—N.V.S.(*Zs*—*Zm*)
::N. V. S. SM—N. V. S. (ZS—ZM):N. V. S. *Sm*—N. V. S. (*Zs*—*Zm*.)

Or N.V. S.(ZS+ZM)—N.V.S.(ZS—ZM)×(N. V. S. *Sm*—N. V. S. (*Zs*—Z*m*.))
=(N.V.S.SM—N.V. S. (ZS—ZM))×(N.V.S.(*Zs*+*Zm*)—N.V.S.(*Zs*—*Zm*.))

Or N. V. S. SM—N. V. S. (ZS—ZM)=N. V. S.(ZS+ZM)—N.V.S.(ZS—ZM) × (N. V. S. *Sm*—N. V. S. (*Zs*—Z*m*.)) / (N. V. S. (*Zs*+*Zm*)—(N. V. S. (*Zs*—*Zm*.)

Or N. V. S. SM
=(N.V. S.(ZS+ZM)—N.V.S.(ZS—ZM)×(N.V. S. *Sm*.—N.V.S. (*Zs*—*Zm*.)) / (N. V. S. (*Zs*+*Zm*)—N. V. S. (*Zs*—*Zm*)

+N. V. S. ZS—ZM=True distance.

J. S.

REMARKS ON MR. SINCLAIR'S METHOD OF FINDING THE LONGITUDE.

Sir,—It gives me considerable pleasure to inform you, for the honour of England as a maritime nation, that notwithstanding the simplicity of the method of clearing the distance in a lunar observation, given by Mr. Sinclair of Dumferline, (No. 315, p. 15,) it is not needed by the teachers of this metropolis, since the common epitomes of Norie and Moore give methods far easier; and even shorter and simpler than these, are given in the linear tables of *Thomson*, *Norie*, &c.

In the example, as printed in the Mechanics' Magazine, the subsidiary work for obtaining the natural versed sine to the nearest second, and for finding the log. of the differences for six places of figures are not at all noticed. Each of these operations will occupy nearly as much time as will be sufficient to perform the whole example by Thomson's tables, at least after the formula is written out. In proof of my assertion, the following is Mr. Sinclair's question, as worked by Thomson's tables:—

☽'s Hor. Par.	61 16	Log. 0·0080	. . . . .	Log. 0·0080
⊙'s App. Alt.	° ′ ″ 56″52	Log. 0·6371	(☽'s App. Alt. 38 24)	Log. 0·6222
App. Dist.	59′28″20	Log. s0.9352	. . . . .	Log. r1·2298
1st Cor.	4″ 0″26	Log. 1·4803	. . . . .	
2nd Cor.	5″22·17	. . . . .		Log. 1·9041
3rd Cor.	1·14			

*—10°+58·52·27 True distance.

In the above examples each log. is taken out direct from the tables, requiring no correction whatever.

Another advantage of these tables is, their cheapness, being no more than ten shillings, and they contain every requisite rule and table for finding the longitude by a lunar observation, or by chronometers, likewise directions for knowing the principal stars, with several other useful problems and tables; it is in fact a most complete compendium for the practical navigator.

For the theoretical student I fully agree with the observation of your correspondent, that Robertson's Navigation and Mackey's Longitude are first-rate books on the subject.

Should the necessity of possessing Thomson's tables be urged as an objection to his method, in comparison with that of Mr. Sinclair's, I may remark, that tables of natural versed sines, are rarely to be met with in nautical tables, nor do I know of any in the common works on navigation, except in Mackey's Longitude, and this work does not contain the common logs. used likewise in Norie's method.

I remain, &c.

ANTHONY PEACOCK,
Teacher of Navigation.

Calvert-street, St. George's East.
Sept. 1, 1829.

HINT TO ASTRONOMICAL TEACHERS.

Sir,—I am sure nothing could be more gratifying to the lovers of *science, than to see the proposition* of your able correspondent, Mr. Steele, for a monument to Sir Isaac Newton, carried into effect. My purpose in now addressing you, is not, however, to enforce that proposition, (which is unnecessary) but to mention an idea which the engraving that accompanies Mr. Steele's paper suggested to my mind. It was this, that astronomy might be taught with a great deal more effect, by delineating the heavenly host on the concave or inner side of a sphere, instead of the convex or outer side. Suppose a lecture-room were to be constructed with two hemispherical domes, each representing a portion of the heavens, the principal stars, path of the sun, &c., could any thing be better calculated at once to beautify the room, and to impress on the minds of the students, the relative position of the objects of their study? Should you think this hint worthy of a place in your interesting periodical, its insertion will oblige,

Your's, &c.
J. W.

MIGRATION OF SWALLOWS.

Prince Charles Lucien Bonaparte, when on board the ship Delaware, about five hundred miles from the coast of Portugal, and four hundred from that of Africa, was surprised by the appearance of a few swallows (*hirundo rustica et urbica.*) An easterly gale of wind prevailed at the time, which had probably blown the swallows out of their course from the main land to Madeira, about two hundred miles distant. These birds were not so much exhausted as might have been expected, from the length of their voyage.

IMPROVED SKATE.

This is not perhaps the most appropriate season for submitting the following improvement to your readers, but frosts, in this country, are quickly "come and gone," and it may be better to anticipate, than delay till they arrive, any subject connected with them. No doubt, many of the readers of the "Mechanics' Magazine," and those, at least who are skaters, have felt the inconvenience occasioned by the shifting of the toe from its right position on the skate, after the strap has been slightly stretched, and not to mention the fracture of a handsomely shaped toe, (of the skate of course, I mean) in the attempt to knock it into its right position, may have suffered as much torture from the buckle of the cross strap from the toe to the instep, as some of our modern beaux and belles from the infliction of a tight shoe in a ball room. To alleviate the sufferings of our fellow-creatures, I take it, is one of the noblest attributes of humanity, and shall therefore think myself entitled to no small share of their gratitude in proposing the above improvement. Let a small toe-piece of strong leather, A, similar to that upon the French clogs, be well secured to the front part; the necessity for a toe-strap will be done away with, and one from the middle of the skate, B, and another, rather backwarder than usual, from the heel at C, will not only keep it steady to the foot, but be found to give much less inconvenience than the present, often painful method of securing them.—the heels must have spikes, not screws.

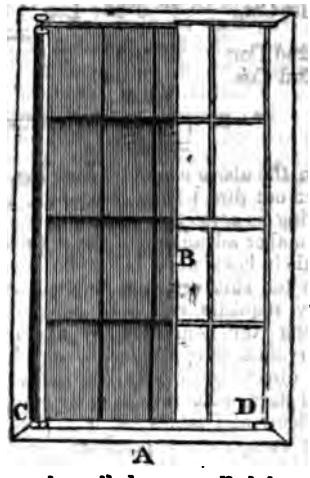
Norwich, J. O. B.
July 22nd, 1829.

PERPENDICULAR ROLLER BLINDS.

Sir,—The blinds of which I now take the liberty to send you a description, are intended either for horizontal or perpendicular rollers, and they can be drawn without using the ordinary *endless cord*. They are not liable to be soon out of repair, and the blind is always well stretched over the window, even when thrown open.

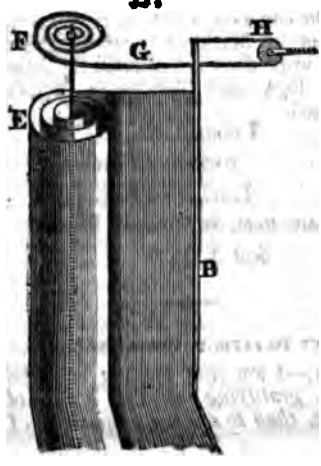
The engraving, Fig. 1. A, is a design for an horizontal roller blind,

1.



it may be rolled or unrolled by applying the hand to the wooden rod, B, at the end of the blind, or by taking hold of the cord running between CD. Here it may be proper to notice that there is a cord corresponding to this one, at the top of the window. This mode of setting up blinds will be better understood by a reference to fig. 2.

2.



In this diagram, which only shews the upper part, in a bird's eye view, it will be observed that the roller for winding the blind upon is to have a grooved wheel at both ends, and that if the blind B is wound up from right to left as at E, the cord F must be the *reverse*, that is, from left to right. The cord F G H is fastened at F to the roller wheel, and passing over a small wheel H, which can be screwed into the casement, is made secure to the rod B. The other end of the roller, &c., is to be prepared after the same manner. If the blind is placed horizontally, the cord may be taken hold of at G on either side of the window, to assist in raising or lowering.

Very neat blinds for the lower row of panes might be made of squares of silk in an oblong frame, each piece being made to draw upon this plan, by using catgut instead of cord; and blinds made in this style would likewise be very suitable for carriage windows.

I am, Sir,
Your's most respectfully,
Henry D—.

EFFECTS OF REFRACTION.

Captain Scoresby, on his return from his first landing on the east coast of Greenland, at Cape Lister, in lat. 70° 30′ N. gave the following interesting account in his journal of an extraordinary instance of the optical phenomena produced by refraction. "It was about 11 P. M., the night was beautifully fine, and the air quite mild. The atmosphere, in consequence of the warmth, being in a highly refractive state, a great many curious appearances were presented by the land and icebergs. The most extraordinary effect of this state of the atmosphere, however, was the distinct inverted image of a ship in the clear sky, over the middle of the large bay or inlet before-mentioned—the ship itself being entirely beyond the horizon. Appearances of this kind I have before noticed, but the peculiarities of this were—the perfection of the image, and the great distance of the vessel that it represented. It was so extremely well defined, that, when examined with a telescope, made by Dollond, I could distinguish every sail, *the general 'rig of the ship,'* and its particular character; insomuch that I confidently pronounced it to be my father's ship, the Fame, which it afterwards proved to be—though, on comparing notes with my father, I found that our relative position, at the time, gave the distance from one another nearly thirty miles, being about seventeen miles beyond the horizon, and some leagues beyond the limit of direct vision. I was so struck by the peculiarity of the circumstance, that I mentioned it to the officer of the watch, stating my full conviction that the Fame was then cruising in the neighbouring inlet."

SINKING OF MOUNTAINS.

Geologists have recorded many instances of mountains sinking into the earth. The following are remarkable:—

In the south of France, on the 23d of June, 1827, a mountain, belonging to the chain of the Cevennes, sunk with an awful crash into the valley of Pradines, overwhelming a small village in its course, and spreading devastation to a considerable distance.

In 1806, a beautiful valley, interspersed with pleasant villages, in Schweitz, a canton in Switzerland, became a scene of awful calamity. During the peaceful serenity of a summer's evening, the inhabitants of five villages, amounting to two thousand souls, were involved in sudden destruction by the falling of the north-east projection of the Rosenberg mountain, which covered more than three square miles of fertile country.

The ignorant attribute phenomena such as these, to the malicious agency of fiends and evil spirits; and foolishly resort to spells and exorcisms to save themselves. The student of Nature views them merely as the effect of plain natural causes—*the sudden expansion of frozen particles of water—the ignition of combustible bodies*—or the mere action of the law of gravity.

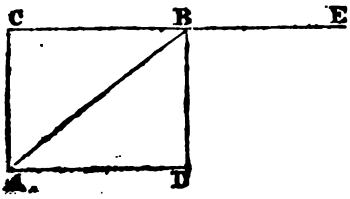
Z.

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS.

Continued from page 63.

If a non-elastic body strike another non-elastic body in a slanting direction, it will not remain stationary, by reason of the resolution of the forces.

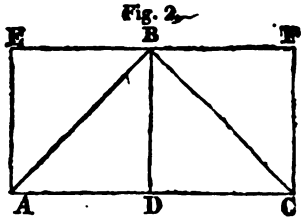
Fig. 1.



Let the line AB (fig. 1,) represent the direction and force of the body A, and let CE be the plane against which it strikes at B. Now, by forming the parallelogram CADB, of which the line AB is the diagonal, it is evident from the principle of the resolution of forces that the force AB may be also expressed by the two forces CB and DB; but the force DB is destroyed by the non-elasticity of the bodies, while that of CB is not at all lessened; consequently it will move in the direction BE.

But if the body and the plane be both perfectly elastic, the motion will not be produced by the resolution alone, but also by the re-composition of forces. It is this which explains the angle of reflection. A perfectly elastic body striking another perfectly elastic body or plane, is rebounded with the angle of reflection equal to that of incidence. It is a well-known fact (or property) that two bodies of this kind when struck together, will return with exactly the same force.

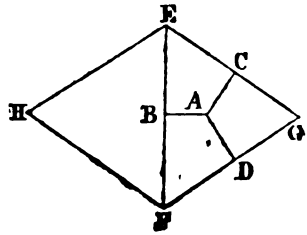
Fig. 2.



Let the line AB (fig. 2), be the direction and force of the body A, striking against the plane EF, at the point B. Now, as in the last figure, by drawing the parallelogram BEAD, the diagonal AB may be resolved into the forces DB and EB Then, by the body hitting the plane, in the direction DB, it will return in that of BD, and with the same degree of *strength, while the force EB is continued* to BF, consequently the motion will then be described by the lines BF and BD, and, by completing the parallelogram BDCF, the force may be represented by the diagonal BC, and the angle FBC will be found to be equal to EBA, or, in other words, the angles of reflection and incidence are equal. This is if the bodies are both perfectly elastic, but the angle of reflection diminishes with their elasticity, until they are both non-elastic, when the angle is lost altogether as before shewn.

The next proposition is, if three forces act on the same point, it is required to discover under what circumstances they will keep that point in equilibrium. Thus, suppose that point to be at A (fig. 3), and the three forces to be expressed by the three lines AB, AC, and AD.

Fig. 3.



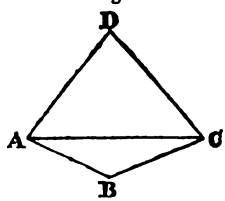
Draw the lines EF perpendicular to AB, also EG to AC, and FG to AD. Now, if the side EF of the triangle EFG, bears the same proportion to AB as EG does to AC and FG to AD, then these three forces will keep the point A, on which they act, in equilibrium. To prove this, complete the parallelogram FHEG, by drawing FH parallel to GE and HE to FG; therefore the diagonal FE, will be equal in effect to the two forces FG and FH, or (as FH is parallel to GE) to FG and GE. In the same manner, it may be proved that any other side is equal in effect to the two opposite sides; therefore, the three forces AB, AC, and AD, neutralise each other's effects, and will, therefore, keep any point on which they act (A) in equilibrium. Thus, a point will be at rest, if the three forces which act on it are in proportion to the sides of a triangle, which are perpendicular to the direction of the respective forces;

or, as this rule may be otherwise expressed—three forces will keep a point in equilibrium, if they are in proportion to the sides of a triangle, which are equally inclined to the direction of those forces. This figure is called the triangle of forces.

It may be observed, that the limits of a resultent, produced by the composition of two forces, are the sum (when they act in the same,) and their difference, when they act in opposite directions, or as it is otherwise expressed, the resultent of two forces, can never be less than the difference, or greater than the sum of those forces.

The next thing is when three forces are given in the same plane, in different directions, to find a single force, whose effect shall be equal to those three.

Fig. 4.



Let AB, BC, and CD, (fig. 4), be the three given forces. Complete the parallelogram ABCD, by joining DA, and AD will be the required force. To prove this, draw the line AC, and as AC would be the diagonal, were a parallelogram to be described on the two sides AB and BC, it may be substituted for those two forces, consequently there are only two forces remaining, to be attended to, viz. AC and CD; when, it is evident, that if a parallelogram be formed on these two lines, the diagonal AD would be a single force, producing the same effect as the two AC and CD; but AC was proved to be equal to AB and BC, therefore, AD is the single force whose effect is equal to that of the three given forces, AB, BC, and CD.

The next proposition, viz. When will four forces acting on a point, keep it in equilibrium? will only require a repetition of the last case, as it is well known that a force, *whose effect is equal to that of these* others, will, if opposed to them, neutralise their effects, and keep a body in equilibrium.

The same rules also apply to motion—Suppose a body receives three impulses, the one moving along AB (fig. 4) in one second, and the others along lines parallel and equal to BC and CD, in the same time. The effect produced will be that the body will move along AD in one second.

By the same method of proceeding as in the last proposition, a single force may be found equal in effect to any number of given forces, and also under what circumstances any number of given forces will keep a body in equilibrium.

Hitherto, all the forces have been supposed to be acting on the same point, but as that is a thing, which seldom or never occurs, the next proposition must be, what effect will be produced by several forces acting on several points?

This problem would be an indeterminate one, as the data on which the results would proceed would be insufficient. As for instance, if a force were to act at each end of an inflexible rod in one direction, and another force were to act in the centre of the same rod, but in a direction exactly opposite, the rod, by reason of its inflexibility, would continue straight; but, the same effect would not be produced, were the rod made of whalebone, or were the forces applied to a piece of rope—consequently, it would be impossible to determine the exact effect produced by different forces on different points of any body, or system, unless those points are connected by some known law.

But, when forces are acting on the same point, it is immaterial whether it is a particle of a solid, a fluid, or of gas—the same principles are applicable to all descriptions of bodies.

It may be proper to explain the proper meaning of the word "System" used above.

"System" is a more general phrase than "Body"—a body is a mass of one constitution or texture, as a rod of iron, &c. But, when it is requi-

rated in different places, and joined at one place by a hinge, at another, by a rope, &c., then it will be called a system, although, when the parts of a system are connected by a law, in virtue of which, the same effect will be produced on all its parts, then it partakes of the properties of a body.

A solid body is the most perfect system, and is supposed not to change its figure.

(To be continued.)

OBSERVATIONS OF THE OCCULTATION OF ALDEBARAN, ON AUGUST 22ND, WITH REMARKS SHOWING THE IMPORTANCE OF THESE PHENOMENA AS THE MEANS OF DISCOVERING THE TRUE FIGURE OF THE EARTH.

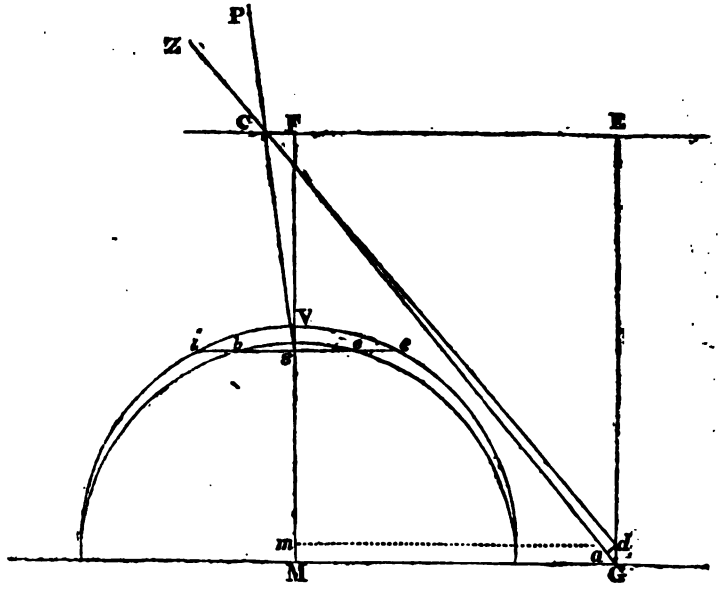
Owing to the unfavourable state of the atmosphere on the morning of the 22nd of August, the occultation of Aldebaran by the moon was only in part observed here; for the moon was obscured by clouds till 42m. after 6, when she became visible, and continued so to the time of emersion, which happened at 7h. 1m. 32s. M. S. T. according to the meridian of the place of observation. From the intervention of a web-like stratus, the dark part of the moon was rendered invisible, and the star much fainter than it otherwise would have been in a bright cerulean sky. Under these circumstances, the phenomena which have been observed to take place on the near approach of the moon's limb to this star could not be observed; and for the same reason, the exact time of the re-appearance of the star might not have been quite so satisfactorily observed as could be wished.

From our more northerly situation, and the relative position of the moon with respect to the star, the absolute time of emersion here, must have been a few seconds later than at Greenwich.

The error of the clock was accurately found by altitudes of the sun's lower limb, taken before and after the occultation, with an excellent reflecting circle made by Troughton. These altitudes were taken alternately by the direct and reverse state of the instrument, and afterwards corrected for the sun's semi-diameter refraction and parallax; thus was obtained the true altitude of the sun's centre at the instant of each observation. From which, with the known latitude of the place, and sun's declination, the time was accurately determined to the fraction of a second. Dollond's achromatic, with a power of 50 only, was used for observing the emersion.

It is well known, that occultations of the fixed stars by the moon, if correctly observed, afford the most accurate means, of any yet known, for determining the true longitude of places on the earth's surface; and, accordingly, much attention has of late been paid to this subject by the Astronomical Society, though not solely with this view, but likewise for the purpose of calling the attention of astronomers to other important circumstances connected with the actual appearance of these phenomena. There is, however, one very important purpose to which many of these occultations could be applied with advantage to science, but which, in a great measure, seems to have been overlooked; I mean that of *determining the true figure of the earth.* It is now nearly ten years since that indefatigable astronomer, Francis Baily, Esq., gave to the world a translation of Cagnoli's memoir, entitled, "A New and Certain Method of ascertaining the True Figure of the Earth, by means of Occultations of the Fixed Stars;" yet little or no notice seems to have been taken of the means afforded by these celestial phenomena for solving this interesting problem; owing probably to Mr. Baily's views of the subject, limiting, in a great measure, the occultations suitable for this important purpose, to those only, where the apparent path of the star is perpendicular to the vertical circle passing through the moon's centre at the time of what may be termed the middle of the occultation. That such occultations are not in general the most proper for determining with precision the variation in the curvature of the earth's surface, may be readily shown by an example. For this purpose let us take the occultation of Aldebaran

on the 6th of October, 1830, in the morning, as well adapted for the illustration of the subject in hand. Although this conjunction ♂ is not expected to prove an occultation at Greenwich, yet to places a few miles southward of the Observatory, the star will be eclipsed by the moon's northern limb; for instance, under the visible latitude of 50° 49′ 30″ N. longitude 0, or reduced latitude for ellipticity $\frac{1}{300}$=50° 38′ 15·1″; which falls at or very near the town of Brighton.



In the foregoing figure, S is the place of the star, C that of the moon's centre at true conjunction ♂ in right ascension, G the apparent place of the same at that time, and M when nearest the star; then will GM represent a portion of the apparent orbit of the moon for the *visible latitude*, parallel to which draw EC, and EG, FM, perpendicular to the same. For the *reduced latitude*, let *d* be the apparent place of the moon's centre at true conjunction ♂, and *m* the same when nearest the star; hence in the latter case *b'e'* will be the chord of duration, and in the former *be*.

Now, without going over the process of computation, it will be sufficient to give the resulting values of the lines and angles of the figure upon both hypotheses, and first, for the *visible latitude* 50° 49′ 30″, and *equatorial horizontal* parallax of the moon=3600·27″. Here we have CS =the difference of declination of the moon and star at true conjunction ♂ in right ascension=1011″, the angle FCS=82° 21′ 59·7″, FC=134·296″, and FS=1002·04″. Again, the parallax of the moon in altitude CG= 2588·34″, the angle ECG=50° 6′ 6·1″; hence EC=1660·23″, and EG =FM=1985·76″; but the moon's apparent semi-diameter=991·05″, therefore MS=983·7, and the chord of duration *be*=240·952″. Now, the visible horary motion of the moon= 1754·4″, hence the time of describing *be*=8m. 14·4s.

For the *reduced latitude*=50° 38′ 15·1″, and corresponding horizontal parallax of the moon = 3593·08″. We have again CS=1011″, but the angle FCS=82° 22′ 16·6″, FC= 134·216″, and FS = 1002·05″. Moreover, Cd, (the moon's parallax in

)—2578·27", the angle ECd
3′ 30·76"; hence EC=1661",
=FM=1971·94"; then tak-
moon's visible semi-diameter
re=991·05", we have *m*S=
), from which the chord of du-
'e' is found=407·4", and the
f describing the same=13m.

Hence it appears that if the
ompression amount to $\frac{1}{300}$ of
rth's radius, the duration of
ultation will be 13m. 56·4s.
there be no variation in the
ire of the earth's surface, the
n will be only 8m. 14·4s.
a difference of 5m. 42s! and
I believe is very near the truth,
the visible orbit is seldom or
right line even for a very short
for this reason had the paral-
effects been computed at the
nearest approach, for the two
es, the result might have been
seconds different from the

Again, if we suppose that in
ultation, the chord of the lunar
hich passes over the star to be
dicular to the vertical circle
the moon's centre, the differ-
n the time of duration would
een only 3m. 51s; making in
of an oblique direction of the
lunar motion, 1m. 51s! That
ample here chosen is not by
eans more favourable for show-
e effects of compression upon
ration, than many others of
phenomena that yearly happen,
e readily shown. Indeed, most
lunar occultations, where the
of sufficient magnitude for ob-
g its immersion and emersion
dly, are equally fit for the pur-
ere proposed to some parts or
of the globe. And as Cagnoli
ustly observes:—"It is in the
of every principal academy
ially to assist in such a dis-
, by two methods. First, in re-
o times *past*, to collect together,
ll quarters, the observations of
ations stated to have been made
given interval; for instance, in
st ten years: and to employ
calculator to select and compute
se which are proper for show-
e variation at different places.
dly, with respect to the *future*,
rt *in the ephemerides* accurate
notices of those places or districts where it would be most important that any occultation should be observed (particularly of the principal stars) in order that it might serve to apprise and excite the attention of such astronomers as might be favourably situated themselves, or contiguous to more advantageous situations."

It is evident, that if this subject were taken up by the different observatories with that degree of spirit which its importance so justly demands, we should, ere long, obtain sufficient *data* for determining, independent of any hypothesis, the true figure of the earth, about which there is at present so much uncertainty.

From the unknown density of the internal *strata* of the earth, and the variableness of the atmospheric refraction near the horizon, it is pretty evident that this end is not likely to be accomplished either by the pendulum or triangulation, if we may judge from the discordant conclusions already obtained from these methods, although conducted with great care, ingenuity, labour, and expence.

In the present example I have supposed *m* to fall on the line MF, as it will do very nearly, the times of nearest approach, in the two cases not differing more than $3\frac{1}{4}$", and EC, without any sensible error, may be considered constant. Hence EG:CG ::$\dot{C}G$:$\dot{E}G$, or, as the *decrement* of CG (*a* G) is to the *decrement* of EG (*d* G).

But $EG \times \dot{E}G = CG \times \dot{C}G$, or $\dot{E}G = \frac{CG}{EG} \times \dot{C}G$, and as CG is greater than EG, the *decrement* of EG will always be greater than the contemporary *decrement* of CG. Much more might be said on the fluxionary relations of the lines and angles arising from the effects of the lunar parallax, by which investigation the most favourable occultations might be pointed out for the purpose here intended.

I remain, Sir,

Your's, &c.

THOMAS SQUIRE.

Epping, Sept. 24, 1829.

MISCELLANEOUS.

Improvements of Light-houses.—It has been suggested that light-houses might be improved, by adding one or more lights below the large light; for example, one at fifty feet below it, and another at one hundred feet below it. The object of this addition would be to enable an observer at sea to determine the distance of his vessel from the light-house. So long as the first of the lights below the great light is below the horizon, the distance may be concluded to be considerable; and when it can be seen, there being a known distance between the two lights, the distance of the vessel may be easily computed, if the angle subtended by the two lights be measured. Every proposal for the improvement of light-houses ought to be examined, in consequence of the importance of these buildings to a commercial country such as our's. The present suggestion, though good, is perhaps not of a nature to be adopted in practice without involving some difficulty, for the lower light ought to be seen in every direction, and in the same vertical line as the upper one. These conditions are not easily obtained. Perhaps the best mode would be to make the lower light revolve round the light-house. And it is essential that the lower light should be as distinct as the upper one, otherwise it might occasion serious errors in hazy weather. Z.

Double Steam-boat of Iron.—A steam-boat has just been built at Liverpool, for the canal between Limerick and Dublin, which is made entirely of iron, and is of a very peculiar construction. When seen out of the water it has exactly the appearance of two vessels joined together by the deck, but separated in every other respect. The paddles, instead of being at the sides, are placed in the middle between the vessels, so that in working they will not injure the banks of the canal, which has hitherto been the principal obstacle to steam-boats being employed in canal navigation.

Method of Separating the Fibre from the Seeds of Cotton.—Windmills are erected in Barbadoes to clear cotton from its seeds. The cotton, when pulled from the pod, envelopes the seeds, and forms a covering for them. To separate it they cause it to pass between two small metallic rollers placed horizontally one over the other, and turned by the windmill. These lie so close on each other, that they will only permit the wool to pass, which falls into a box on the opposite side, while the seeds fall in front of the rollers.

To correct Damaged Grain.—Musty grain, totally unfit for use, and which can scarcely be ground, may, it is said, be rendered perfectly sweet and sound by simply immersing it in boiling water and letting it remain till the water becomes cold. The quantity of water must be double that of the corn to be purified. The musty quality rarely penetrates through the husk of the wheat, and in the very worst cases it does not extend through the amy-laceous matter which lies immediately under the skin. In the hot water all the decayed or rotten grain swims on the surface, so that the remaining wheat is effectually cleansed from all impurities, without any material loss. It is afterwards to be dried, stirring occasionally, on the kiln. Z.

Migration of Eels.—Upon the head of Benmore, one of the promontories near the Giant's Causeway, in Ulster, are two small pools or lochs, from which a small stream trickles over the rocks into the sea. Up this steep channel young eels, not thicker than small pack-thread, ascend to the lochs, where they thrive exceedingly. *This migration is so regular all along the coast, that the peasantry at the proper season* lay hay-bands down the rocks to assist the progress of the young brood, from which a rich supply of food is anticipated when the eels are full grown, eels being a great favourite in the north of Ireland.

The Manita Tree, so named from the resemblance of its flower to a little hand, (manita) is a species of plant almost unknown in the catalogues of botanists. It is sometimes supposed that only three specimens are in existence; two in the small botanical garden at the palace of the city of Mexico, and one at the town of Toloca. It is certain nobody in Mexico can tell whence they originally came, or where they may be found growing in a wild state; but as they were preserved with many other foreign productions by the emperor Montezuma, it is imagined either himself or ancestors must have obtained them from the interior of South America. The tree is about forty feet high, with a smooth trunk, without branches almost to the top; but the boughs then stretch over a considerable distance, with large leaves and numerous flowers hanging downwards from amongst the foliage. It bears a stronger resemblance to the plane or the tulip-tree, than any others we are acquainted with in Britain. Two of this species were found by the Spaniards at the time of their conquest, and form a solitary exception to the devastations of those adventurers; most probably because Cortez occupied the site of the palace for his own residence, and therefore coveted the shade of its garden; the smaller plant now growing at Mexico is considered to have been a sucker from the other. Tradition states, that though the Indians did not actually worship the manita tree, yet they regarded the flower with a sort of religious veneration.—*Mexican Illustrations.*

INTERIM NOTICES.

We regret that the engraving of Mr. Saddington's new sliding Rule has not been finished by the promised time to enable us this week to present to our readers his valuable communication; it will positively appear in the next number.

Communications received from N. V. S.—T.—G. P. W.—A Constant Reader.—S. R.—P. M.—J. D. R.—An original Supporter.—W. B.—T. K.—X.—G. A. E.—Omicron.

ERRATA.

The wood-cut, bottom of p. 53, should have exchanged places with that near the top of p. 54.

P. 55, col. 2, l. 1, for "AB 4 D," read "ABCD."

Ibid. col. 2, l. 2, for "D 4," read "D C."

Ibid. 5th line from the end of the article by G. S. for "104·7197126+12," read "104·7197126×12."

P. 96, col. 2, l. 20, for "absorption," read "compression."

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M. SALMON, Printer, Fleet Street.

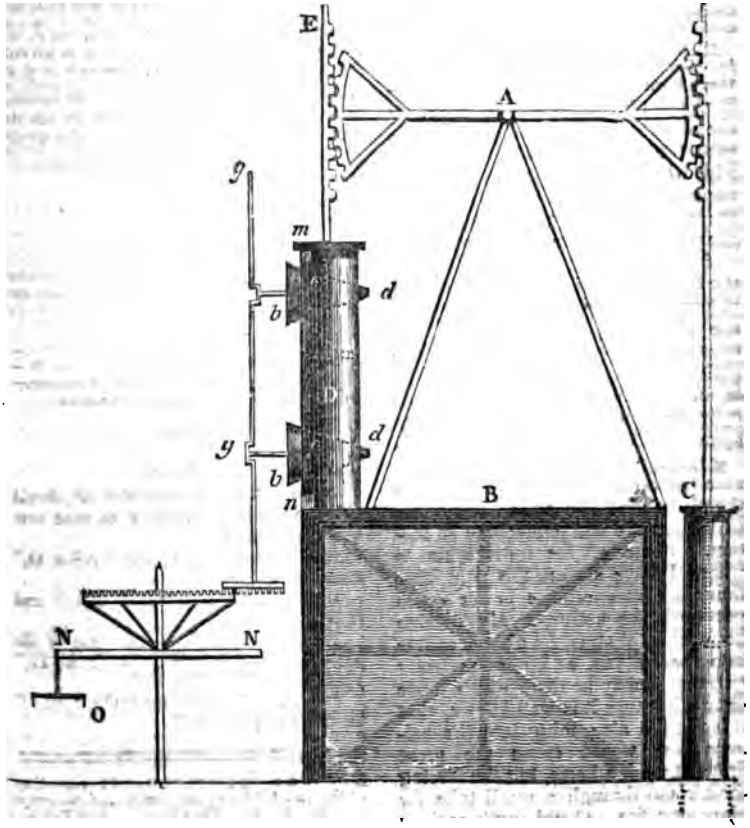
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 322.] SATURDAY, OCTOBER 10, 1829. [Price 3d.

"To be happy in old age, it is necessary that we accustom ourselves to objects that can accompany the mind all the way through life, and that we take the rest as good in their day. The mere man of pleasure is miserable in old age, and the mere drudge in business is little better: whereas, natural philosophy, mathematical and mechanical science are a continual source of tranquil pleasure. Those who knew Benjamin Franklin will recollect, that his mind was ever young; his temper ever serene; science, that never grows grey, was always his mistress. He was never without an object, for when we cease to have an object, we become like an invalid in an hospital, waiting for death."

MACHINE FOR LIFTING WATER, DRIVING A CORN-MILL, THRASHING CORN, &c.



AIR MACHINE FOR LIFTING WATER, DRIVING A CORN-MILL, THRASHING CORN, &c.

Sir,—After showing the following plan to some learned gentlemen, and mechanics, they generally allowed, that there was no doubt of a machine of this kind answering effectually. I take the liberty, therefore, of transmitting it to you, in the hope that you will give it a place in the Mechanics' Magazine.

Description.

A (see prefixed engraving) is a working beam the same as in the steam-engine, B the frame that supports it, C a pump, D a cylinder, E the piston, *bb* two pairs of bellows, *cc* valves by which the air is sucked into the bellows, *dd* valves that discharge it. Now, the bellows being made to contain a little more air than the one half of the cylinder, when the crank G lifts the bellows, the bellows suck the air out of the bottom of the cylinder, and the piston comes down, by the air acting upon it through a valve *m* at the top of the cylinder. Likewise when the upper crank G lifts the upper bellows, it sucks the air out of the upper part of the cylinder, and the piston ascends upwards by the air acting upon it through the valve at the bottom of the cylinder at *n*; the valves upon the bellows at *c* and *d*, are placed so, that when the one opens the other closes, which the action of the air in the bellows does itself. Likewise the valves upon the cylinder *m* and *n* must be made to open and close from the action of lifting the upper parts of the bellows, to give the air free access to act upon the piston; NNO are the horse gears, which put the whole machine in motion. Some of the individuals to whom I have shown this plan have thought that one-horse power could not work the bellows. My opinion however is, that as the air comes free into the bellows, and goes as freely out, that it may be done with a horse or two, because it is well known, that it is not the air coming into the bellows that would cause the great draught upon a horse, but the forcing the air out through a small tube for blowing a fire. Could any ingenious mechanic bring a machine of this kind to perfection, it would be a general service to all parts where coal or water is not easily got.

I am, &c.

H. OGLE, Schoolmaster,
Rennington by Alnwick,
Northumberland.

May 20, 1829.

GRAND MECHANICAL COMPETITION—RAIL-ROAD RACE FOR £500.

The great rail-road between Liverpool and Manchester being now nearly completed, the directors of the undertaking sometime ago announced that they would give a premium of £500. for the locomotive engine, which should, at a public trial to be made on the 1st of the present month of October, (afterwards postponed to the 6th) draw on the railway a given weight with the greatest speed at the least expence. The offer of so handsome a premium, and the brilliant professional prospects which the winning of it presented to mechanical men, naturally exerted a very lively spirit of competition among them. In almost every quarter of the country, engine makers and engine inventors set themselves to work to secure the prize, and the result, we are happy to say, has been such as to furnish a lasting example of the wisdom of calling into action, and giving fair play to *the general talent of a country*, when any great public object has, as in the present instance, to be accomplished.

At all hands, the directors of the Liverpool and Manchester railway, deserve thanks for their conduct on this occasion, from their constituents, for the good sense and liberality which dictated a competition by which the capability of the railway, to do all that was promised, and much more, has been at once placed beyond all doubt, and the chances of a profitable return for the money invested in it increased at least tenfold; from the owners of the competing engines, for the liberal encouragement by which they were induced to *start for the plate*, and the impartial spirit, (divested of all local and personal in-

fluences) in which the competition has been conducted, and from the nation at large, for the powerful impulse which this demonstration of the extraordinary celerity with which carriages may be propelled on railways, must give to the more extensive adoption of this mode of conveyance throughout the kingdom.

The principal conditions on which the prize was offered were these:— 1st. That each engine entered for the competition should weigh not more than six tons, and be capable of drawing after it, day by day, on a level plain, a train of carriages of a gross weight, equal to three times the weight of the engine itself, at a rate of not less than ten miles per hour, with a pressure of steam in the boiler not exceeding 50lb. on the square inch. 2. That the engine and boiler should be supported on springs, and rest on six wheels, and the height from the ground to the top of the chimney should not exceed 15 feet. 3. That the engine should "effectually consume its own smoke;" and 4. That there should be two safety-valves, one of which should be completely out of the reach of the engine-man's interference.

The gentlemen appointed by the directors to act as judges on the occasion, were J. U. Rastrick, Esq., of Stourbridge, civil engineer, Nicholas Wood, Esq., of Killingworth, civil engineer, (author of the excellent work on railways) and John Kennedy, Esq., of Manchester.

The portion of the railway chosen for the "running ground" was on the Manchester side of Rainhill Bridge, (about nine miles from Liverpool) where the railway runs for two or three miles on a dead level.

Early on Tuesday, the day of competition, great crowds of people were assembled from all parts, to witness the sight. There were many individuals who had come hundreds of miles for no other purpose; and, as may readily be supposed, these were not idle spectacle hunters, but chiefly engineers and men of science capable of appreciating, in its full extent, the great importance of the exhibition.

The number of competitors was at first reported to be ten, and we have reason to know there was at least as many engines as this in preparation. In this new sort of race, however, as in others, there were some withdrawn, and some prevented by accidents from making their appearance; and the number was reduced on the morning of trial, to five, who were thus described in the official list of *the running coaches*:—

No. 1. Messrs. Braithwaite and Erickson, of London; "The Novelty;" copper and blue; weight, 2 tons 15 cwt.

2. Mr. Ackworth, of Darlington; "The Sans Pareil;" green, yellow, and black; weight, 4 tons, 8 cwt. 2 qrs.

3. Mr. Robert Stephenson, Newcastle-upon-Tyne; "The Rocket;" yellow and black; white chimney; weight, 4 tons, 3 cwt.

4. Mr. Brandreth, of Liverpool; "The Cycloped;" weight, 3 tons; worked by a horse.

5. Mr. Burstall, Edinburgh; "The Perseverance;" red wheels; weight, 2 tons, 17 cwt.

The engine which made the first trial, was the "Rocket" of Mr. Robert Stephenson (the son, we believe, of Mr. George Stephenson, the engineer of the railway.) It is a large and strongly-built engine, and went with a velocity, which, as long as the spectators had nothing to contrast it with, they thought surprising enough. It drew a weight of twelve tons, nine cwt. at the rate of ten miles four chains in an hour, (just exceeding the stipulated maximum,) and, when the weight was detached from it, went at a speed of about eighteen miles an hour. The faults most perceptible in this engine, were a great inequality in its velocity, and a very partial fulfilment of the condition that it should "effectually consume its own smoke."

The next engine that exhibited its powers was "The Novelty" of Messrs. Braithwaite and Erickson. The great lightness of this engine, (it is about one half lighter than Mr. Stephenson's) its compactness, and its beautiful workmanship, excited universal admiration; a sentiment speedily changed into perfect wonder, by its truly marvelous performances. It

was resolved to try first its speed merely; that is at what rate it would go, carrying only its compliment of coke and water, with Messrs. Braithwaite and Erickson to manage it. Almost at once, it darted off at the amazing velocity of twenty-eight miles an hour, and it actually did one mile in the incredibly short space of one minute and 53 seconds! Neither did we observe any appreciable falling off in the rate of speed; it was uniform, steady, and continuous. Had the railway been completed, the engine would, at this rate, have gone nearly the whole way from Liverpool to Manchester within the hour; and Mr. Braithwaite has, indeed, publicly offered to stake a thousand pounds, that as soon as the road is opened, he will perform the entire distance in that time.

It was now proposed to make a trial of the "Novelty," with three times its weight attached to it; but through some inattention as to the supply of water and coke, a great delay took place in preparing it for its second trip, and by the time all was ready, the day was drawing so near to a close, that the directors thought it proper to defer the prosecution of the competition till the following day.

[The preceding report brings the proceedings of this interesting competition down to the date of the latest arrivals from Liverpool, previous to the time of our weekly sheet going to press. In our next Number, we shall give the conclusion, with a full description, and engravings of Messrs. Braithwaite and Erickson's engine. EDIT.]

FLUXIONS.

ON THE MAXIMA AND MINIMA OF VARIABLE QUANTITIES.

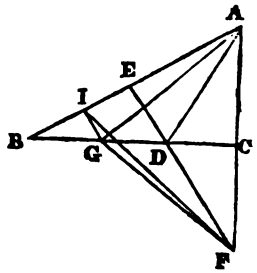
(Continued from p. 373, vol. xi.)

We are now prepared to answer D. C.'s objections. Suppose the

A D C D′ B

straight line AB (fig. 1) is bisected in C, and let D be any point between A. and C. Then AD·DB will continually increase as the point D approaches to the point C (5 and 2 Elem.); in that case the fluxion of AD·DB will be positive. But when the point D has passed the point C, AD·D′B will continually diminish, and ∴ the fluxion of AD′·D′B will be negative; therefore C is the only point in the line AB where the fluxion of AD·DB is = O. It therefore follows from the definition that the problem does not admit of a minimum, and is a maximum when AC=CB. Or suppose it was required to find the position of D, so that AD^2+DB^2 is a minimum. In this case AD^2+DB^2 will continually diminish as the point D approaches to C (9 and 2 Elem.), and will afterwards increase. And, reasoning exactly as above, AD^2+DB^2 will be a minimum when D coincides with C. ∴ The first problem admits only of a maximum, and the second of a minimum.

In the solutions of some problems, the result is sometimes in appearance ambiguous, but even in that case we have resources for removing the ambiguity. Thus, suppose it was required to find a point D in the base of a right angled triangle ABC (fig. 2),

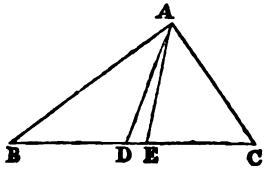


so that by drawing DE perpendicular to the hypothenuse AB, AD+DB may be a maximum or a minimum.

Assume BC=a AB=b, AC=c DC =x. ∴ DB=$a-x$; hence AD=$\sqrt{c^2+x^2}$ and by similar triangles AB : AC :: BD : DE or $b:c::a-x:\frac{c}{b}(a-x)$; hence $\sqrt{c^2+x^2}+\frac{c}{b}(a-x)$=max. or min. in fluxions $\left(\frac{\dot{x}}{\sqrt{c^2+x^2}}-\frac{c}{b}\right)\dot{x}=o$ or $c\sqrt{c^2+x^2}=b\,x$, from which $x=\frac{c^2}{\sqrt{b^2-c^2}}=\frac{AC^2}{BC}$=DC or BC : AC :: AC : DC.

Now, it is not evident whether the above solution gives the result a maximum or a minimum, or either. But in order to ascertain this, produce AC to F, making CF = AC, and draw FDE perpendicular, AB join AD. Then the triangles BDE and DCF are similar, and each similar to ABC and ADC ∴ BC : AC :: AC : DC, agreeing with the fluxionary solution. Now in BC take other point G, join GF GA, and draw GI perpendicular to AB. Then evidently AD+DE = FE, and AG+GI = FG+GI. But FG+GI > FI, and FI > FE, or DA+DE, much greater then is AG+GI than DA+DE; therefore DA+DE is a minimum. It must, however, be remarked, that BC must not be less than AC, otherwise the point D would coincide with B, or would be in CB produced.

Problem 3d. Given the base the sum of the other two sides: To determine the sides when the sum of the squares of two lines drawn from the vertical angle, one to bisect the base, and the other the vertical angle, may be a maximum or a minimum.



Let BC (fig. 3) $=a$, AB+BC = S AB $=x$. ∴ AC = S − x.

Since BD = DC ∴ $AB^2 + AC^2 = 2BD^2 + 2AD^2$. ∴ $AD^2 = AB^2 + \frac{AC^2}{2} - \frac{2BD^2}{2} = 2x^2 - 2Sx + \frac{S^2}{2} - \frac{a^2}{4}$. Again, because AE bisects the angle BAC· AB : AC :: BE : EC by composition AB + AC : AB :: BC : BE or S : x :: a : $\frac{ax}{S}$ = BE. ∴ EC = $a - \frac{ax}{S} = a\left(\frac{S-x}{S}\right)$.

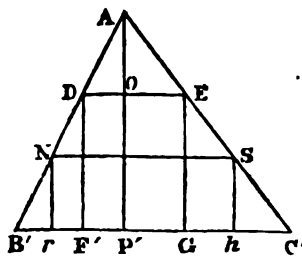
Again, AB·AC = BE·EC + AE^2 ∴ AE^2 = AB·AC − BE·EC = $Sx - x^2 - \frac{a^2Sx}{S^2} - \frac{a^2x^2}{S^2} = \frac{S^2x}{S^2} - \frac{S^2x^2}{S^2} - \frac{a^2Sx}{S^2} + \frac{a^2x^2}{S^2}$ ∴ $\frac{S^2x - S^2x^2 - a^2Sx + a^2x^2}{S^2} + \frac{2x^2}{2} - \frac{2Sx}{2} + \frac{S^2}{4} - \frac{a^2}{4}$ = max. or min. By rejecting constant quantities, we have by reduction $x^2 - Sx$ = max. or min. in fluxions $(2x - S)\dot{x} = o$. ∴ $x = \frac{S}{2} = AB$; and $S - x = S - \frac{S}{2} = \frac{S}{2} = AC$. Now, if for x we substitute a quantity somewhat less than $\frac{S}{2}$, the fluxion $(2x - S)\dot{x}$ will be negative; but if we substitute a quantity greater than $\frac{S}{2}$, the fluxion $(2x - S)\dot{x}$ will be positive. Hence, by article 60, vol. 2, page 327, of the Woolwich Course of Arts, 24, 25, &c. to 29, Dealtry's Fluxions, the expression $x^2 - Sx$ is a minimum when $x = \frac{S}{2}$. The same may be otherwise demonstrated, as follows:

When AB = AC, the points D and E coincide. In that case $AD^2 + AE^2 = 2AD^2 = \frac{S^2}{2} - a^2$. Now, suppose $AB = \frac{S}{2} \pm v = S - \frac{S}{2} \mp 2v$. ∴ $AC = S - \frac{S}{2} \mp 2v$; hence $AD^2 = AB^2 + AC^2 - 2BD = \frac{S^2}{2} + 4v^2 - a^2$.

Also, $AE^2 = AB \cdot AC - BE \cdot EC = \frac{S^4}{4S^2} - \frac{4S^2v^2}{4S^2} + \frac{4a^2v^2}{4S^2} - \frac{a^2S^2}{4S^2}$. ∴ $Ad^2 + AE^2 = \frac{2S^4}{4S^2} - \frac{2a^2S^2}{4S^2} + \frac{4d^2v^2}{4S^2} = \frac{S^2}{2} - a^2 + \frac{a^2v^2}{4}$; which is greater than $\frac{S^2}{2} - a^2$. ∴ the squares of AD and AE is a minimum when AB = AC.

The following problem admits of several maxima.

Prob. 4. Suppose a log of wood is of the form of a given triangular prism. It is required to cut out of it the strongest rectangular log.



Let ABC (fig. 4) represent a vertical

section of the given triangular prism, and DEGF a section of the strongest rectangular log. Draw AP perpendicular to BC.

Assume BC=d, AP=P DF=x. $\therefore$ Ao=P—x, and by similar triangles AP : BC :: Ao : DE, or P : a :: P—x : $\frac{a}{P}$ (P—x)=DE. Then, by mechanics, the log DEGF will be the strongest possible when DF^2 × DE is a maximum. or when $\frac{a}{P}$ (P—x) x^2 or Px^2—x^3= max, in fluxions (2 Px—3x^2) $\dot{x}$=o or 3x=2 P. $\therefore$ x=$\frac{2}{3}$ P=DF. $\therefore$ DE $\frac{a}{3}$ ($\frac{2}{3}$ P—x) =o and DF^2 × DE=$\frac{4\,a^2P}{27}$.

But we might suppose NShr another section of the log, so that Nr × NS^2= max. in that case, by proceeding as above, we would find Nr × NS^2=$\frac{4\,a^3\,P}{27}$. $\therefore$ of the two rectangular logs DEGF, NShr the strongest will depend upon the values of a and P that is, if a > P, $\frac{4\,a^3\,P}{27}$ will be greater than $\frac{4a\,P^2}{27}$. Or we might have four more sections by drawing perpendiculars to the sides AC and AB from the angels B and C. Then assuming AC=b, AB=c, and the respective perpendiculars m and n, we may obtain, as above, $\frac{4bm^2}{27}$, $\frac{4b^2m}{27}$, $\frac{4cn^2}{27}$, $\frac{4c^2n}{27}$, and from the sides and perpendiculars of the triangle ABC being given, we can easily determine which of the six sections produces the maximum maximorum.

I am, Sir, your's, &c.

G. S.

THE ELECTRICAL STAR AND BRUSH OF LIGHT.

Fig 1.

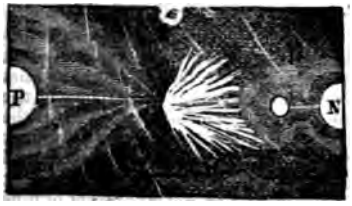
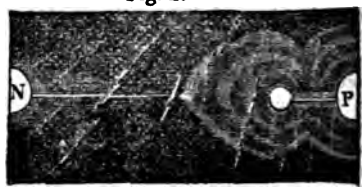


Fig. 2.



Sir,—Perhaps the following attempt to illustrate, how the star and brush of light are produced, the one by negative, and the other by positive electricity, will not be devoid of interest, to many readers of your very instructive Magazine.

I shall for this purpose take up the theory of Cavallo, as laid down in his Complete Treatise upon Electricity, published in 1795, where he supposes the conductor to be surrounded alternately with zones of electrified and unelectrified air.—These are shown, slightly visible in the accompanying diagrams, fig. 1, and fig. 2.

The plus or positive conductor, is marked P, and the minus, or negative conductor, distinguished by N.

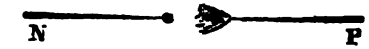
We shall first consider the brush or lucid pencil, of rays issuing from the pointed termination of a positive conductor, fig. 1, P, towards the conducting body, N, possessed of no more than its natural share of electricity, or it may be negative. The strata of air, in a plus and minus state, are represented thickly surrounding P, highly condensed on the wire, and then brought to a focus at the apex, from whence the electric fluid flies with considerable vehemence, in the direction of the body N. And zones of electrified and unelectrified air have already commenced forming around N.

The next phenomena is the lucid star, or globule of light, seen at the tip of the pointed wire or needle;

affixed to the conductor N, fig. 2, which, whether it be in a negative or natural state, makes no difference; for, in either case, it is capable of acquiring electricity by induction, and with this view, we use the positive conductor P. P is enveloped in zones as before described, and N has possessed itself of a faint degree by contact. Now, before N was brought near P, the latter was, as it were, embedded in various strata, without their being materially more concentrated in one part than in another, when, however, the point of N is brought to bear upon them, the strata rushing towards it, become so dense at the point of the metal as to appear in the form of a speck of light. But if we ask why, in the former instance, we have a brush, and in the latter only a star of light, it will, perhaps, be easier to reply to the query, by referring to the figs. 1 and 2, than by any written description. In the two engravings, it will be observed that that only is the dense lucid fluid, which has the appearance of what is termed the electrical brush, and the electrical star. It may be affirmed, that in *both* these experiments, there is a brush of the electric fluid; the difference is, that in flowing *from* a point, the brush is one of concentrated fluid, but when rushing *to* a point, it is dense enough to be visible only at the place of contact.

To bring this idea home to the commonest understanding, an apt illustration is afforded by the blowpipe, with which a *stream* of air may be produced drawing air into it (according to the colloquial phrase) or by forcing it from the lungs through the tube, in either way we obtain a stream, but how much do these differ in their powers — the latter will possess its strength for some distance beyond the tip of the pipe—the latter has no power except just where it enters the bore. We see, therefore, the reason why there may be a brush, or stream of electric fluid flowing from or towards a point, and yet in one case only, of sufficient density to be visible

If we insulate the rubber of an electrical machine, and also the conductor, and use two wires, one proceeding from the back of the rubber, the other from the conductor, on bringing them pretty near to each other, thus



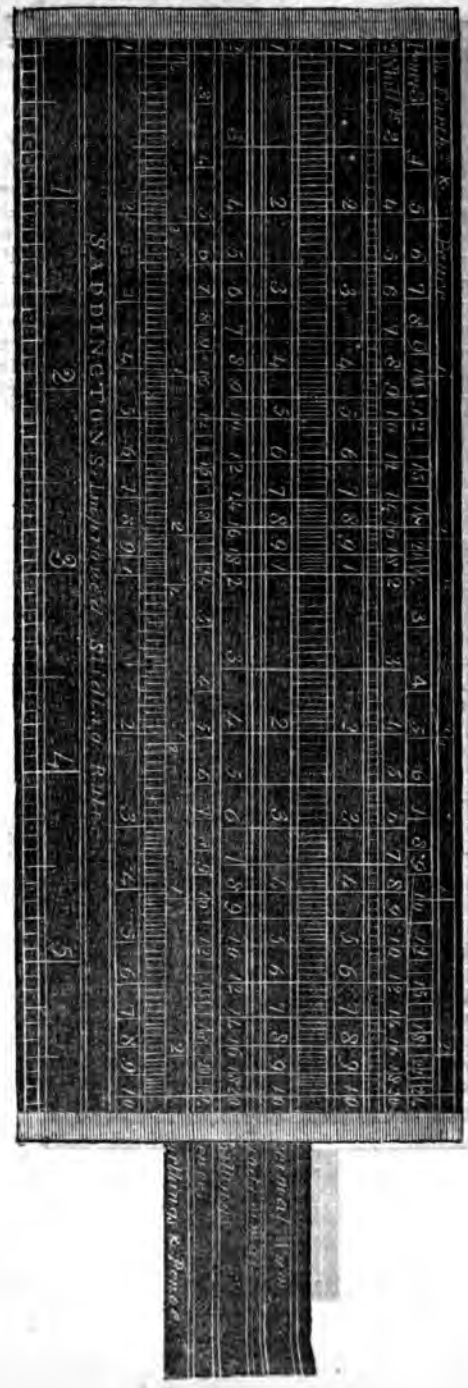
we shall find the wire belonging to the rubber, negative, and that of the conductor, positive; and the fluid while it rushes from P to N, will be at the end of the wire P, in the form of a brush of light, and at the point of N, it will be seen as a star. Were it possible to force the electric fluid with greater velocity in the direction P, N, we might then expect an arc of brilliant light, somewhat similar to that described as attending the combustion of carbon fixed to the negative and positive wires of a powerful galvanic arrangement.

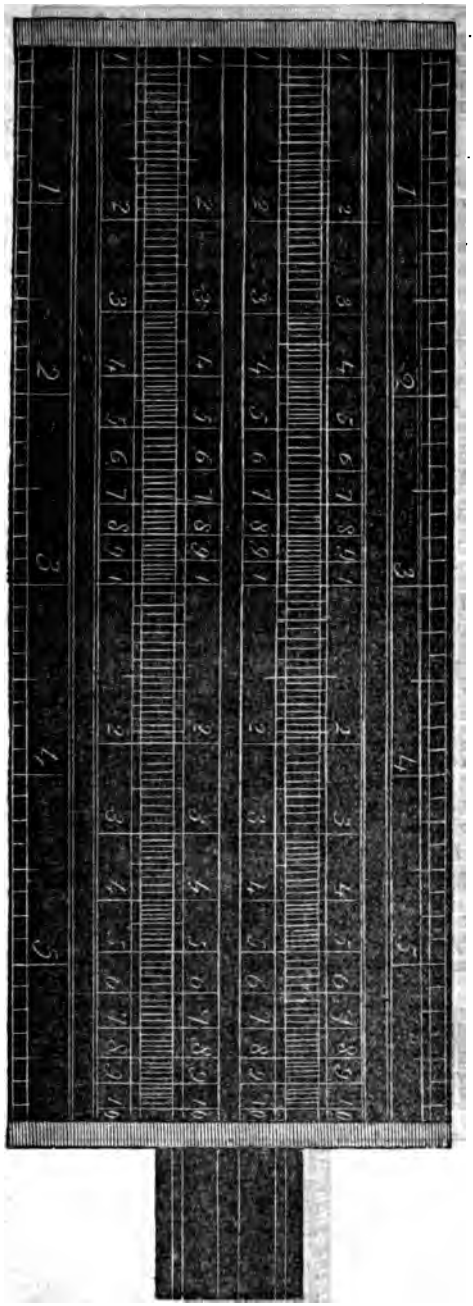
I now beg to remain,
Sir,
Your obedient servant,
H. D.

Finsbury, Sept. 1829.

RESISTANCE OF THE AIR.

M. Benedict Prevost devised the following simple experiment, to prove that the retardation in the fall of light bodies arises solely from the resistance of the air. Place a piece of thin paper at the bottom of a small box, of such a weight that in falling the bottom of it will always keep lowermost. Let the box now fall from the height of eight or nine feet above a cushion, and the paper and the box will both reach the cushion at the same time, just as if the paper had clung to the bottom of it. If the same piece of paper is allowed to fall by itself from the same height, it will flutter slowly and obliquely to the floor. The experiment will succeed equally well if the piece of paper is placed upon a crown or half-crown piece, without using a box. The rapid descent of the paper when placed on the box is in no way owing to any adhesion between it and the bottom of the box, but to the circumstance of there being no air to obstruct its descent, the advance of the box in front of the paper having the same effect as if there was a perfect vacuum before the piece of paper. A little box of lead, or piece of lead with round edges, is best for making the experiment.


SADDINGTON'S Improved Sliding Rule.



INSTRUMENTAL ARITHMETIC.

DESCRIPTION AND USE OF AN IMPROVED SLIDING-RULE, ADAPTED TO ALL PURPOSES OF COMMON ARITHMETIC. BY THOMAS SADDINGTON.

Sir,—Some years ago I devised or invented (if you will allow the term) several very important improvements in the common decimal or Gunter's sliding-rule, which I have denominated the Improved Sliding-Rule; and I have now drawn up a concise description and illustration of its principles and advantages over the decimal rule, in all departments of common arithmetic. The description is adapted to a rule six inches long, which is a convenient size for the pocket; yet a rule of two feet long will be more suitable for the desk, and solve the questions with fourfold greater accuracy. As it is an original invention, and has never been made public, you will probably consider it deserving a place in your Magazine. It is my intention (on some future occasion) to submit to your readers a few short and plain directions for laying down the lines of a sliding-rule of any given length, by means of a table of logarithms.

I remain, Sir,
Your obedient servant,
THOMAS SADDINGTON.

No. 8, Upper John-street,
Commercial-road.

Description.

The sliding-rule, containing a line of numbers laid down in decimal divisions, by means of logarithms, and generally called Gunter's line, is an instrument well known amongst mechanics.

The advantages derived from the improved sliding-rule, over the one in common use, consists in being divided duodecimally as well as decimally, whereby it is rendered applicable for working and solving nearly all questions in arithmetic, in pounds, shillings, pence, and farthings, (in proportion to the size of the instrument) by one operation, which cannot be done simply by the decimal line of numbers.

As this communication will probably fall into the hands of many persons unacquainted with the nature and use of the *common sliding-rule*, it will be proper to make a few general observations, illustrative of its construction, when applied to plain or integral numbers.

On one side of this rule, which is six inches long, (and may be termed a pocket-rule) are laid down a double radius of the line of numbers marked N. This line contains the logarithms of the number, or, more properly, the number corresponding to the logarithm, and is figured thus—near the left hand end of the rule is 1; and towards the right hand is 2, 3, 4, 5, 6, 7, 8, 9, and then 1 in the middle, going still on 2, 3, 4, 5, 6, 7, 8, 9, and 10 at the end.

The first 1 at the left hand may be counted for 1, or 10, or 100, or 1000, &c., and then the next 2 will be 2, or 20, or 200, or 2000, &c.; so that if the first 1 be esteemed 1, the middle 1 will be 10, and 2 towards the right hand will be 20—3 will be 30, and 10 at the end will be 100. Again, if the first 1 is counted 10, the next 2 will be 20—3 will be 30, and 1 in the middle will be 100; the next 2 will be 200—3 will be 300, and 10 at the end will then be 1000. In like manner, if the first 1 be estimated one-tenth part, the next 2 is two-tenth parts, and the middle 1 is then 1, and the next 2 is 2, and 10 at the end will be 10.

As the figures are increased or decreased in their values, so in like manner must all the intermediate strokes or subdivisions be increased or diminished; that is, if the first 1 at the left hand be counted 1, the 2 on the right hand of it is 2, and each long stroke or subdivision between them is one-tenth part, and the short strokes between the subdivisions make twentieth parts. Between 2 and 5 are ten strokes, each being one-tenth part. Between 5 and 1 in the middle are five strokes, each being one-fifth, or two-tenth parts; the 1 in the middle will now be counted as 10, the next 2 will be counted 20, and each long stroke will be 11, 12, 13, 14, 15, 16, 17, 18, 19; and 2 for 20, and so on to 5, which will be 50; from 5 to 10 there are only five strokes between each figure, which are counted 52, 54, 56, 58, and 6 for 60, and so to 10

at the end, which will be counted 100. If 1, either at the left hand or in the middle, is counted 100, 2 will be 200, 3 will be 300, &c., to 1 or 10, which will be 1000, and between 1 and 2 each long stroke will be ten, and the short stroke five. Between 2 and 5 each stroke will be ten, and between 5 and 1 or 10 each stroke will be twenty. If 1 is counted for 1000, then each of the foregoing must be increased in a tenfold proportion; and if 1 is counted for 10,000, then each must be increased an additional tenfold, and 2 will be 20,000, and so on to 1, which will be 100,000, &c.

From this short description it will not be very difficult to find the division representing any particular number, and as the figures and lines on each radius are exactly alike, either half of the rule may be used. The double set being laid down for the purpose of solving questions in proportional arithmetic, which cannot be done in most cases with only one set of figures and divisions. The figures on the stock or fixed part of the rule, and on the slide, are also exactly alike.

Supposing the point representing number 12 were required, take the division at the figure 1 in the middle and call it 10; then count two-tenths or long strokes towards 2 on the right hand, and that division will be the point representing the number 12. Again, suppose it is required to find the number 22, call the figure 2 for 20, then two strokes towards 3 will be the required point. Again, required 55, call 5 for 50, and two strokes and a half towards 6, between the second and third strokes, will be the required point. If 1 in the middle had been called 100, then 12 would have been 120, and 22 would be 220, and 55 would be 550.

Before I proceed to illustrate the advantages of the common sliding-rule, when applied to plain or integral numbers, and the improved sliding-rule in solving all questions in common arithmetic, it will be necessary to make two general observations, deduced from mechanics and optics, and which must be kept constantly in view throughout the whole of the following communication, in order to prevent any disappointment in the expectations of the young practitioner.

First. What you gain in power you lose in velocity, and what you gain in velocity you lose in power, that is to say, as the principle of one increases, the other decreases. Or, perhaps, secondly, the idea intended to be conveyed may be better illustrated from optics than mechanics, by the use of the telescope or spy-glass, for the apparent magnitude of an object and distinctness of vision are in proportion to the distance from the observer. An object distinctly seen at a given point will not be seen with the same degree of magnitude at a tenfold distance, and it would be seen with still less accuracy if removed to one hundred times the first distance from the observer. The sliding-rule rests on a similar principle, as will be easily seen by examining the proportionate distance of figures laid down upon it. The higher the numbers go, the less space is allowed for the respective divisions—the same space that is allowed from 1 to 2 is only allowed from 4 to 8, and the same from 8 to 16. Again, the space given from 1 to 10 is only allowed from 10 to 100, and also the same from 100 to 1000; so that it will be readily granted, that the higher the numbers are, the less accurate will be the estimated value of your calculations; but in descending from high numbers, the accuracy is increased in the ratio of the two extremes, in the same manner as the observer of an object with a spy-glass, on moving nearer to it, in a tenfold proportion, would view it with an increased magnitude in the ratio of the decreased distance.

Note.—In using the sliding-rule, it is not intended that it should supersede the use of figures in the common mode of making calculations where accuracy is required, but the utility of the rule will be fully acknowledged as a corrector in all operations, in proportion to the size of the instrument, for, by adjusting the slide to the respective questions, the solution is instantly obtained, whereby the calculator will be enabled to judge if his computations are correct, if not, the error, if considerable, will be immediately detected. Where great

accuracy is not necessary, and only the proximate value or amount of any question is required to be instantly ascertained, or in working of low numbers, much gratification will result from the use of this instrument.

I shall now proceed with the illustration, in working a few examples in multiplication, division, and the rule of three, which is the ground-work of every other rule of proportion, in arithmetic.

Multiplication.

Multiplication is performed by placing the figure and division denoting the multiplier, on the slide under unit, or 1, on the stock or fixed part of the rule and counting on towards the right hand, or back towards the left hand, until you come to the figure or division denoting the multiplicand, and under which you will have the product or sum total on the slide.

Examples.

1st. Multiply 4 by 2.

Here 2 is the multiplier; place the figure 2 on the slide, under 1 on the stock; by drawing the slide out towards the right hand, (or putting it back towards the left hand) until 2 on the first radius or half part of the slide comes under 1 on the middle of the stock, (or if the first 2 is made use of to be under 1 at the left hand) from thence count onwards to the right hand, until you come to the figure 4 on the stock, under which, on the slide, you have the figure 8 for the product required.

2nd. Multiply 15 by 2.

Keep the slide in the same position as before, and call 1 on the middle of the stock for 10, and count five of the long strokes which will be 15, and under that division on the slide is the figure 3, which now denotes 30 for the answer, the 1 having been increased tenfold, and called 10.

3rd. Multiply 45 by 2.

Keep the slide in the same position as before, and count on to 45; viz. to the figure 4 and five of the divisions or strokes, which will denote 45, and under that point on the slide is the figure 9, now to be called 90, for the product required.

4th. Multiply 2 by 12.

Here 12 is the multiplier, which point place under 1 on the middle of the stock, and counting on to the right hand to the figure 2, the multiplicand, under which you have 2, and four of the strokes will give 24 for the product. In order to find 12, the multiplier, call the first 1 on the stock for 1, and the middle 1 for 10, and the two next long strokes will represent 12 for the figures sought.

5th. Multiply 30 by 12.

Keep the slide as before, and count 3 for 30 on the stock, under which, on the slide, you will have 3 and four strokes, which will represent 360 for the product. If it had been 3 multiplied by 12, this point would then have been called 36.

Division.

Division is the reverse of multiplication, and is performed by placing the figure and division denoting the dividend on the slide under the figure, and division denoting the divisor on the stock, and under unit, or 1, on the stock, you have the answer or quotient on the slide.

Examples.

6th.—Divide 4 by 2.

Here you place 4, the dividend on the slide under 2, the divisor on the stock, and under 1 on the stock you have 2 on the slide for the quotient required.

7th. Divide 8 by 4.

Keep the slide as before, and look for 8 upon it for the dividend over which you have 4 on the stock for the divisor, then, under 1 you have 2 on the slide, for the quotient of 8 divided by 4.

8th. Divide 30 by 2.

Here you place 3, signifying 30, on the slide under 2 on the stock, and under 1 on the stock you have 15 on the slide for the quotient, by calling 1 for 10, and counting onwards to 15, which is five of the long strokes towards 2.

Rule of Three

The rule of three, or rule of proportion, is performed nearly in the same manner as multiplication. For the second term on the slide under the first term on the stock, and under the third term on the stock, will be

, or answer required on

Examples.

as 4 what will 4 give?
1 second term on the
the first term on the
r 4, the third term on
be 8, the fourth term
the answer required.
res 6 what will 8 give?
le fixed as before, and
ive that 6 the second
3 the first term, and
rd term, you will find
1 on the middle of the
nd six of the longer
nswer required.
ives 36, what will 42

ace 36 on the slide
e stock, and under 42
n will have 63 on the
swer required.
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S' INSTITUTIONS.

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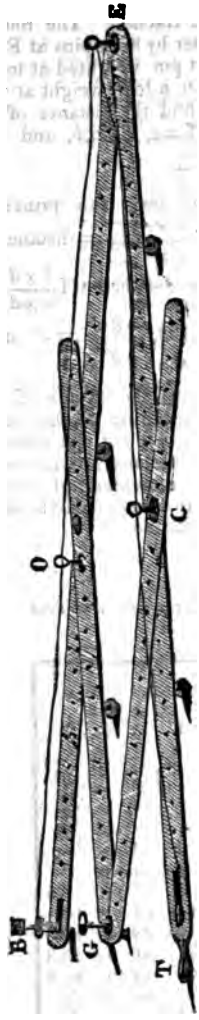
aster tradesmen wish to
g men well instructed,

and parents their sons usefully employed in those leisure hours which are too often spent in irregularity and vice, they will enter into a virtuous coalition, and by giving a right direction to the mind and pointing out the benefits of mental cultivation, the School of Arts may be rendered an important blessing to society. Masters and employers will find their advantage in the superior skill and judgment of well-educated apprentices; parents will have the satisfaction of seeing their sons advancing in the path of knowledge, free from the vicious habits attendant upon ignorance and idleness; and the rising race of mechanics will be amply rewarded by the fair prospect of preferment, which *art improved by science* will undoubtedly command. It is well known that there is no period of life so dangerous to the morals of young persons as that which intervenes between their removal from school and the expiration of their apprenticeship; that is the time in which injurious associations are formed and bad habits contracted. Let the vacant hours of that unguarded season be rationally and usefully employed, and every youth that is thus led on in the path of science, and trained up in the way he should go, will be an honour to himself and a credit to his country If merchants, master-tradesmen, and artists will do their duty, the School of Arts and all similar institutions may be converted into moral engines of great national importance. What can be more easily effected than to give preference on all occasions to the studious, the moral, the skilful, and the correct? The names of the pupils and their various mechanical engagements are registered on the books of the Institute. Let application be made to the directors for persons of talent and skill, and as soon as it is discovered that merit is rewarded, and that men are selected to places of trust and emolument according to the scientific and moral character they have obtained, journeymen and apprentices will press forward to the School, and a noble strife for preferment and fame will be encouraged by every ingenious and virtuous artisan. In the course of a few weeks, I shall have occasion to apprentice my own son to some useful trade, and such is the high opinion I entertain of the advantages to be derived from the School of Arts, that I will, if possible, introduce a clause into the indenture, *making it a part of his duty to become a pupil in that valuable institution.*"

DESCRIPTION OF AN IMPROVED PANTAGRAPH.

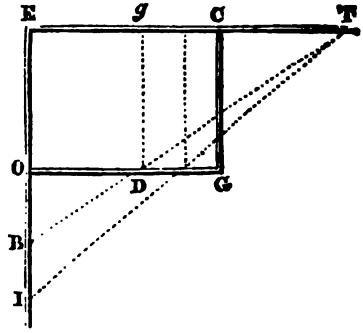


Sir,—Your correspondent "Keysoo" is wrong in supposing that "the pantagraph is hardly ever used;" on the contrary, there are few instruments more useful to the practical draughtsman. The encyclopedias, it is true, give but a slight account of its construction, and none whatever of its mathematical principles; even that in Adams' Geometrical Essays, is *slight and* unsatisfactory.

Considering the simplicity of its principle, and its utility in practice, you will not perhaps refuse a corner of your useful Magazine to the following account of it. I also subjoin a figure and description of a pantagraph, which I believe is not very generally known, but which, from its portability (packing into less space than a fishing-rod) and the greater surface it is capable of reducing without the trouble of shifting, possesses many superiorities (in the reduction of large plans, &c.) over the instruments in more common use.

The pantagraph consists of four brass rods, two long and two short, moving on fixed centres E, C, G, O; a sliding-box attached to a cylindric tube moves upon the longer rod EI, and another on the shorter rod OG, both these rods are graduated for the different proportions; a similar tube is fixed at T. One of these tubes contains the tracer, another the pencil, and the third the fulcrum. The position of each varying under different circumstances, as is evident from the following

Mathematical Principles.



Let E, C, G, O, in the above figure represent the centres on which the parallelogramic part moves, E the common centre of the rods ET, EI,—T the fixed tube, and B and D the two moveable ones. Now, if B be the fulcrum, it is evident that the ratio of the moving points T and D will be, TB:TE::DB:DO, in any position of the line TDB or distauce of the points T, D, B, because the triangles TgD, DOB, are similar .'. distances TB, DB, are in the same ratio as the

sum of the sides TE+EB and DO+OB.

The ratio of BT to BD is always given, and EO is a fixed quantity, also known.

To find the distance OB for any ratio of TD to DB—Let TB=a, DB=e, EO=b and OB=x. $\therefore a:e::b+x$ $\therefore ax=be+ex$. $\therefore ax-ex=b$ and $x=\frac{be}{a-e}$, a general theorem with the fulcrum at B or T.

Again, let the fulcrum be at D, then—TD:DB::Dg:OB—let TD=a, DB=e. $\therefore a:e::b:x$ and $x=\frac{eb}{a}$, a general theorem with the fulcrum at D.

The engraving prefixed to this communication represents a pantagraph made with four straight rods, with holes at equal distances along the middle of them; a tracer T, which slides within a groove, the length of one division; and a pencil B, sliding in the same manner, the length of two divisions; a scale of decimal parts of a division is placed upon the rod ET next the tracer, for the purpose of setting the tracer and pencil to any required fraction. The rods are fixed together by brass pins at E, O, C, and a stout pin weighted at top and passing into a lead weight at G.

To find the distance of the joints, let ET=a, EB=b, and the proportion=$\frac{c}{d}$.

Then from the principles given above, $\frac{a\times c}{c+d}=y=$ distance EC, $\frac{y\times d}{c}$ $=x$ or distance CT, $\frac{b\times d}{c\times d}=y'$ or distance EO, $\frac{x\times y'}{y}=x'$ or distance OB.

To save the trouble of calculation at each setting of the instrument, I have drawn out the following table. The proportions given, as will be seen, are for a pantagraph whose tracing rod is 48 inches or divisions long, and pencil rod 45.

TABLE

Showing the Distance of the Joints as set for different Proportions.

Proportion.	Distances.			
	Tracing Rod 48 Inches.		Pencil Rod 45 Inches.	
	E-C	C-T	E-O	O-B
Equal	24	24	22	22
1 to 2	16	32	30	15
—— 3	12	36	33	11
—— 4	9	36	36	9
—— 5	8	40	37	7·4
3 to 4½	19	28·5	27	18
—— 5	18	30	28	16·8
—— 7	14	32·6	31	13·3
—— 7½	13	32·5	32	12·8
—— 8	13	34·6	32	12
—— 10	11	36·6	34	10·2
—— 11	10	36·6	35	9·5
—— 13	9	39	36	8·3
—— 15	8	40	37	7·4
—— 20	6	40	39	5·8
—— 25	5	41·6	40	4·8
4 to 9	14	31·5	31	13·7
5 to 7	20	28	26	18·5
6 to 10	18	30	28	16·8
8 to 9	22	24·7	23	20·5
—— 10	21	26·2	25	20
9 to 10	22	24·4	23	20·7

"I" (No. 301) appears to have rated the superiority of the camera lucida over "the unwieldy construction of bars, joints, and pullies," rather too high. *Query.* Does "I" understand the use of the pantagraph? The camera lucida may be a very clever instrument for copying views, &c.; but is it capable of reducing plans or drawings to any required proportion? I have never seen one, nor can I meet with a drawing of it in the encyclopedias, which take but slight notice of it. Perhaps "I" or some other correspondent could furnish a drawing and description.

I am, Sir,

Your's obediently,

J. O. B.

Norwich, Aug. 11, 1829.

MUSCULAR STRENGTH.

Borellus was the first who demonstrated that the force exerted within the body greatly exceeds the weight to be moved without, and that nature, in fact, employs an immense (we had almost said superfluous) power to move a small weight. It has been calculated that the deltoid muscle alone, when employed in supporting a weight of 50 pounds, exerts a force equal to 2,568 pounds. Some notion of the force exerted by the human body in progressive motion, may be formed from the violence of the shock received when the foot unexpectedly impinges against any obstacle in running. The strongest bones are occasionally fractured by the action of the muscles. The muscular power of the human body is indeed wonderful. A Turkish porter will run along carrying a weight of 600 pounds; and Milo, of Crotona, is said to have lifted an ox weighing upwards of 1000 pounds. Haller mentions, that he saw an instance of a man, whose finger being caught in a chain at the bottom of a mine, by keeping it forcibly bent, supported by that means the weight of his whole body, 150 pounds, till he was drawn up to the surface, a height of 600 feet. Augustus II. King of Poland, could, with his fingers, roll up a silver dish like a sheet of paper, and twist the strongest horse-shoe asunder; and a lion is said (Phil. Trans. N. 310) to have left the impression of his teeth upon a piece of solid ron. The most prodigious power of the muscles is exhibited by fish. A whale moves with a velocity through the dense medium of water, that would carry him, if continued at the same rate, round the world in little more than a fortnight; and a sword-fish has been known to strike his weapon quite through the oak plank of a ship.

MISCELLANEOUS.

Printing as Rapid as Writing.—We have examined a curious machine invented by Mr. Bart, of Macomb county, called by him a typographer. Its object is to enable a person to print with the same rapidity with which he can write, and to make one or more impressions, at the same time, to the number of twelve. The letters of the alphabet are stereotyped together in a curvilinear groove, and affixed to a rod, one end of which moves upon a swivel, and the other is held in the hand. An index is immediately before the eye of the operator, where the letters are also arranged, and a notch corresponding with each letter is cut in a brass plate. The paper to be printed on is passed over a bar with a proper edge, covered by a cloth, and is moved by a roller; and the person operating has only to put the rod in the notch corresponding with the letter which he wishes to print, and the impression be made. The elevation of the rod from the notch moves the paper just far enough for another impression, and so on till the work is complete. The downright movement not only makes the impression, but keeps the types sufficiently provided with ink. The operation is as rapid as writing, and far less fatiguing. The machine is not less curious for its mechanical ingenuity than for its admirable simplicity. Bishop Wilson said, that the time would come when a man preparing for his journey would call for his wings as familiarly as for his boots. We have no doubt but the time is near when a man, to prepare his epistle, will instantly resort to his typographer, instead of his pen and ink.—*American paper.*

Malleability of Platina.—When a piece of platina is heated in a furnace, great care should be taken that no part of it is exposed to the blast in the chimney, for that part immediately loses its primative malleability, and becomes as brittle as zinc.

INTERIM NOTICES.

The Editor being absent from town, attending the Locomotive Engine competition, of which some account is given in this week's Number, he requests his Correspondents will rest satisfied with a general acknowledgment of their favours till his return.

Communications received from Kappa—Henry D—A Constant Reader—Mr. Saul—Mr. Woollgar—J. N.—A Private Teacher—Mr. H. Guest—Mr. J. Gilbert—Mr. Chapman—T. R.—J. B.—Mr. James Harrison.

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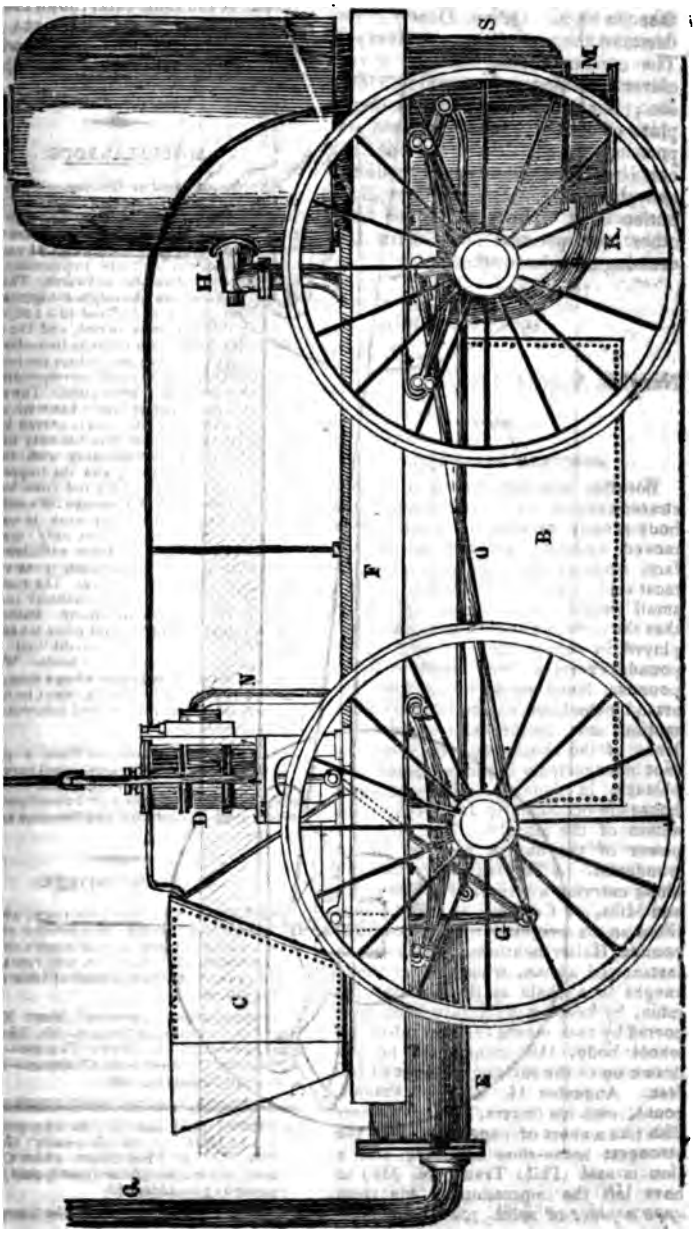

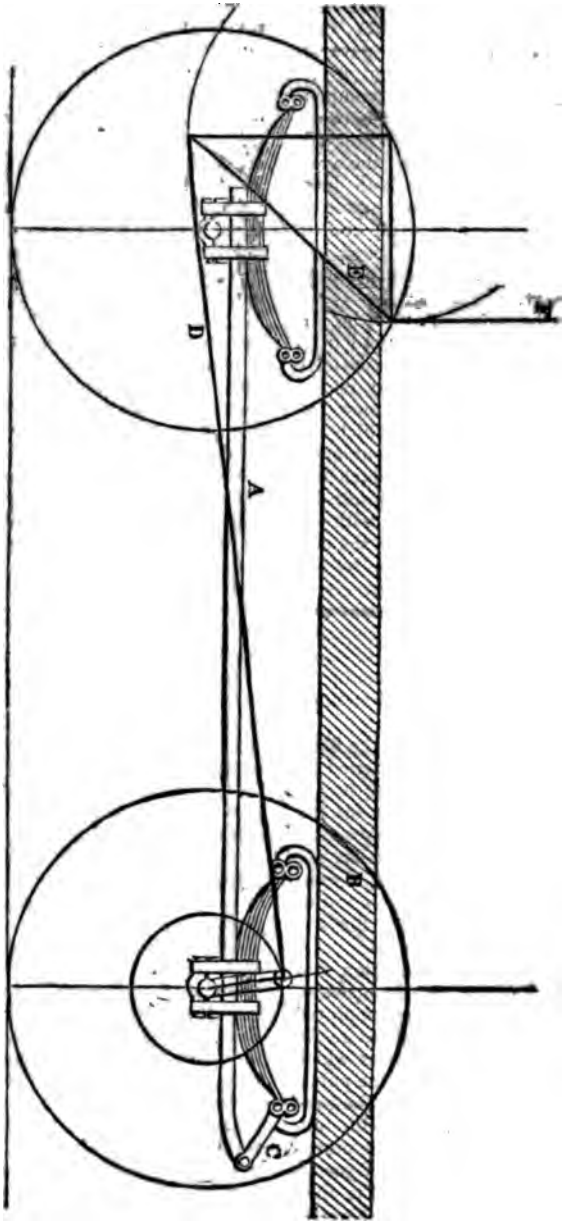
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ITION OF LOCOMOTIVE CAR-ES ON THE LIVERPOOL AND CHESTER RAILWAY.

ur last Number we gave an t of the commencement of this ing and important competi- rawn up on the spot, between ing of the first day's proceed- d the departure of the post, cessarily therefore both brief perfect. We now propose to the subject *de novo*, and to it with all the fulness and tantiality which it so pre-emi- deserves.

ay be necessary for the in- on of some of our readers to , that though railways have r more than a century in use at Britain, and are now ex- numerous, the one which has e scene of the present com- is but the third which has nstructed in Great Britain for use; that is to say, with the superseding entirely the em- nt of ordinary roads, by the at large, as far as carriages of criptions are concerned; and wn to the day of this competi- was still a question of some whether a railway could be d possessed of such extensive ities.

first undertaking of the kind Surrey Railway, designed by sop; but the only use as yet f that road has been for the nce by horses of heavy goods, s of three or four miles per nd in consequence of its pass ugh a country of little traffic, rather disappointed the ex- ns of its projectors.

second was the Stockton and ton Railway, on which steam- as for the first time employed l passengers as well as goods, h a degree of success which o open the eyes of the public ntages of which they had not eamt in connection with rail- veyance. It was here proved r the employment of steam- s a speed of from five to eight hour, according to the weight was readily attainable; and expence of this mode of con- was one-half, in some in- stances two-thirds cheaper than any other. Inside passengers were conveyed at the rate of 1½*d.* per mile, outsides, 1*d.*; and the price of coals, which used at Stockton to be 15*s.* and 17*s.* per ton, was all at once reduced to 10*s.* 2*d.* From the 29th of September, 1825, when this railway opened, to the 29th of September, 1826, its receipts increased progressively from £700. to £1500. a month; and in the second year it had drawn to it nearly the whole carrying-trade between Stockton, Richmond, Darlington, Yarm, &c. The turnpike-road, too, which may be said to have been thus beaten out of the field, is actually four miles shorter than the railway; for to accommodate Darlington and Yarm, a more circuitous line was taken than would otherwise have been necessary.

As early as 1822, and of course long before these favourable results were known, the Liverpool and Manchester Railway had been projected by William James, Esq., Civil Engineer, and all the necessary surveys for it made by Mr. Vignoles, another able and intelligent member of the same profession; but in consequence of the strong opposition which was threatened by the whole body of canal proprietors throughout the kingdom, and other causes, the prosecution of the design languished till the progress of the Stockton and Darlington Railway towards completion; and the success of some preliminary trials upon it, animated the people of Lancashire with a new zeal in behalf of their own speculation. A deputation of gentlemen was appointed, consisting of Messrs. Ellis, Sanders, and Booth, of Liverpool, and Mr. Kennedy, of Manchester, to proceed to the north to inspect the Stockton and Darlington Railway, and also some collieries in the north of England, where locomotive steam-engines have for several years been employed to transport the coal-waggons to the nearest land or water communication. The report made by this deputation was so satisfactory, that it was immediately determined to prosecute the plan of the Liverpool and Manchester Railway with the greatest vigour: the whole capital required was subscribed within

a few weeks; and in the following session of Parliament an Act was obtained containing all the requisite legal powers. The Act met, as had been anticipated, with a great deal of opposition; but as that opposition had no better foundation than the resistance made by the land-carriers of a preceding age to the introduction of canals, it necessarily shared a similar fate. The Marquess of Stafford, who was at first its most powerful opponent, became at length so satisfied of the superior advantages which it promised to confer on the country, that his Lordship not only withdrew his opposition, but purchased a thousand shares in the concern.

In the summer, or rather autumn of 1826, the formation of the railway commenced under the direction of Mr. George Stephenson, of Newcastle-upon-Tyne, who had been appointed by the Company to carry the design of Mr. James into execution. The natural character of the country through which the road passes, made the undertaking one of considerable difficulty, as will be readily perceived from a simple detail of the work which Mr. Stephenson had to perform. There were, first, two tunnels, one 2200 yards, and the other 291 yards long, to be excavated under the town of Liverpool, and afterwards six considerable eminences to be cut through; these excavations too had mostly to be made through solid rock (red sandstone), and amounted altogether to upwards of two millions of cubic yards. While in some parts it was thus necessary to hew out a level with the pickaxe, there were others where the level had to be maintained by raising artificial mounds (or embankments as they are less properly called), bridges, and viaducts. One of these mounds, called the Broad Green Embankment, rises to an elevation of 70 feet above the level of the surrounding country; another, which is about four miles long, extends over a moss (Chatmoss) which three years ago was scarcely passable even to pedestrians. Of bridges and viaducts the number required to be erected on the line was 25; one of which (the Sankey) was to consist of nine arches of 50 feet span, and another (the Newton) of four arches of 30 feet span; besides which, there were to be 36 culverts of large dimensions, with several of a smaller size. When we consider the great number and variety of these works, the difficulty of some, and the stupendous nature of others, it is really wonderful to think how much has within the space of three brief years been accomplished. Both the tunnels, all the bridges but one (that over the Irwell), and all the culverts, have been already finished; and so nearly have the different mounds and excavations been likewise completed, that of 33 miles (the estimated length of the railway) only about 4 miles remain to be executed. We need scarcely say how greatly all this redounds to the honour of the engineer. So much work of a difficult description could not have been performed in so short a time (and it is but fair to add so well), unless the labour bestowed on it had been under most intelligent direction. There are some things which are slow works of time, but here we see art triumphing over time; the labours of the head far transcending those of the hand.

It is now understood that early in the spring of next year, the whole of the railway from Liverpool to Old Field Road, near the site of the intended bridge over the Irwell, will be ready for travelling on; and that the opening may not be deferred till the erection of that bridge, it is proposed to erect a wharf and warehouses at Old Field Road, where the railway will be considered to terminate, until the continuation of the line into Manchester is completed.

The rails have been as yet laid down on about fourteen miles of the road only; but as this is a matter which requires little time, no delay is apprehended on this account.* The sort of rail employed is that called the edge-rail, in contradistinction to the flat rail or tram-plate, now so generally abandoned where ease of draught is consulted; not however

* In a Description of the Tunnel, published in Liverpool, the railway is called "a grand *tram* road:" evidently a grand mistake.

ommon edge-rail, but that par- description for which Mr. shaw, of the Bedlington Iron s, has a patent. The following ption of the construction and tages of these rails we extract he Supplement to the Encyclo- Britannica :—

he flat rail has been now almost y superseded by the edge-rails, are now generally admitted to be ily superior; the edge of the bar ting less friction, and being less to clog up with dust and mud, or obstructed with stones driven off ad upon the surface of the rails. ge-rail consists merely of a rec- ar bar of cast-iron, three feet three or four inches broad, and ne half-inch to one inch thick; its edge between sleeper and , and bearing on the sleepers at emities. The upper side of the launched out to present a broader surface for the wheels, and the ide is also cast thicker than the for the sake of strength. But atest strength is evidently at- by casting the rail not rectangu- t deeper in the middle than at s, to resist better the transverse The ends may be safely reduced to one-third of the depth in the and still be equally strong. e the rails together, and at the me preserve them in their places their upright position, and to em also to the sleepers, they are cast-iron socket or chair, which bed firmly to the sleeper. This mbracing the extremities of the t rails, which are here made to a little, a pin is driven at once the rails and through the sock- binds the whole together. This neral method of uniting the ils, but the shape and dimensions netal chair and of the overlap of ls are varied according to the nt and taste of the engineer. dge-railways have come into neral use, an essential improve- is been made in their construc- the use of malleable iron, in cast-iron, in forming the rails. rantage of malleable iron rails they are less subject to breakage st-iron: a circumstance of im- e in this case, where it is not avoid those jolts and sudden which cast-iron is least of all of withstanding, and though ould happen to give way they ily repaired. They can also be laid in greater lengths, and requiring therefore fewer joints; they can be bent with ease to the curvature of the road: when worn out they are of greater va- lue; and, lastly, their first cost is very little, if at all, greater than that of cast- iron rails. Malleable iron is, no doubt, less able to stand exposure, decaying more readily under the influence of air and moisture; but hitherto this incon- venience has not been felt, and on the whole the malleable iron is now de- cidedly preferred. These rails are laid and joined in the same manner as the cast-iron, only in greater lengths."

The writer then proceeds to describe Mr. Birkinshaw's improvement—

"An improvement has lately been made in the construction of malleable iron rails, which promises to be of es- sential utility. It consists in the use of bars, not rectangular, but of a wedge form, or swelled out on the upper edge. In the rectangular bar, there is evidently a waste of metal on the under surface, which, not requiring to be of the same thickness as where the waggon-wheel is to roll, may be evidently reduced with advantage, if it can be done easily. The bar may then be made deeper, and broader at the top than before, so as with the same quantity of metal to be equally strong, and present a much broader bearing surface for the wheel. The peculiar shape is given them in the rolling of the metal, by means of grooves cut in the rollers, corresponding with the requisite breadth, and depth, and curvature of the proposed rail. Mr. B. recommends his rails to be of 19 feet in length. We have seen one of these patent rails at Sir John Hope's colliery; and it certainly forms the most perfect iron rail which has hitherto been con- trived; combining very simply and in- geniously in its form the qualities of lightness, strength, and durability. It is twelve feet long, two inches broad along the top, about half an inch along the bottom, and still thinner between. It rests on sleepers at every three feet, and at those places the rail is two inches deep, while in the middle point between the sleepers it is three inches deep. All these inequalities, we believe, are pro- duced on the metal by means of the rollers; and this circumstance is well deserving of attention, as it may ob- viously be applied not merely in the formation of railways, but to a variety of other purposes in the arts. The moulding and shaping of the metal in this manner is quite a new attempt in the iron manufacture, and it is not easy

to say how far such an invention may yet be carried by the skill of British artists."

Mr. Stephenson, it will be seen, had good reason for the preference he has given to Mr. Birkinshaw's rails. An engineer of great experience whom we met at the present competition, suggested what we think would be a great improvement in them; namely, that they should overlap at the extremities in the same way, in fact, as most of the old edge-rails did. The advantage of an unbroken continuity in the bearing surface seems not to have been sufficiently consulted.

The total cost of the railway is not expected to be much less than £650,000, or about £20,000 per mile. This is much more than was ever before expended on a railway; but the excess is to be accounted for partly by the number of deep cuttings, lofty embankments, &c., which were necessary, and partly by the circumstance, that compensation had to be made to the proprietors of the ground assumed for the purposes of the railway, while in most other cases there has been no need for such compensation; railways being, nine times out of ten, constructed by individual proprietors on their own lands, and for their own exclusive benefit. Were the expence however even to exceed £650,000—nay, to be even twice or thrice as much—we are convinced there will be revenue enough to yield a handsome return. The traffic between Liverpool and Manchester is probably greater than what exists between any other two points of the kingdom. The one being the principal port for the importation of cotton, and the other the chief seat of its manufacture: this alone serves to unite them in bonds of the closest alliance. The total quantity of merchandize passing between the two towns is stated to be 1200 tons per day; and though it is not to be expected that the same result will take place here as has been exhibited in the case of the Stockton and Darlington Railway, (for the Liverpool and Manchester Railway will still have the Irwell and Mersey navigation to contend with, and probably at reduced rates,) yet if only one-half of this immense traffic is transferred to the railway, it will at 2d. per ton each mile yield an annual income of £62,478. 13s. 4d. The carriage of passengers may reasonably be expected to add to this sum at least £25,000 more.

The profit to be derived by the shareholders forms however but a minor consideration, compared with the vast advantages that will result to the inhabitants of Liverpool and Manchester, and indirectly to the nation at large, from increasing the celerity and cheapness of communication between the two towns. But to appreciate duly what is likely to be effected in these respects on this new line, we must pause a moment to reflect on what was the maximum of effect previously realized on the Stockton and Darlington Railway. It was not more, as we have before stated, than eight miles an hour; and the idea of any thing much beyond that rate was generally scouted as visionary. Mr. Wood, who published his book on railways, after the opening of the Stockton and Darlington Railway was pleased to say, "It is far from my wish to promulgate to the world that the *ridiculous* expectations, or rather *professions* of the enthusiastic speculatist will be realized, and that we shall see engines travelling at the rate of *twelve, sixteen, eighteen*, or *twenty* miles an hour. Nothing could do more harm towards their adoption or general improvement than the promulgation of such *nonsense!*" The Directors of the Liverpool and Manchester Railway appear to have had nearly the same impressions when they offered the present premium of £500 for "the most improved locomotive engine." They stipulated that it should be "capable of drawing after it day by day on a well-constructed railway, on a level plane, a train of carriages of the gross weight of 20 tons, including the tender and water-tank, at the rate of *ten miles per hour*." More they did not ask for; and as if to evince how perfectly they agreed with Mr. Wood as to the "nonsense" of expecting more, they selected that gentleman to be one of the judges of their competition.

The proceedings on the first day of this competition are already before our readers. It has been seen from them that Mr. Wood has been spared to see, not only what he declared to be "ridiculous" and "nonsense," reduced to an unquestionable matter of fact, but of witnessing something so much more extraordinary, that had any one hinted it to him in his days of incredulity, he would we presume have pronounced it to be absolute madness. The least powerful of the two engines which then exhibited reached nearly the highest degree in Mr. Wood's scale of "nonsense," having gone without any load at the rate of about eighteen miles an hour; while "The Novelty" of Messrs. Braithwaite and Ericsson actually realized almost double that speed!

"When we consider," says a writer, in the Liverpool Chronicle, "that at this rate of going, Liverpool and Manchester, which are at present near half a-day's journey distant, will be brought within an hour's travel of each other; and pass from this fact to the contemplation of the vast changes which so rapid a mode of conveyance will effect in all the relations of society in this quarter of the kingdom, we feel at a loss for examples with which to contrast this great triumph of human ingenuity." But suppose we go a step farther, and estimate what the effects will be of extending this system of communication over the whole kingdom; what mind is there so comprehensive as to embrace all the important consequences to which it will lead? We think we shall not go too far in saying, that it will produce an entire change in the face of British society. The effect will be much the same, as if the workshop of the manufacturer were brought alongside the quay where he obtains his raw material, and whence he sends it forth again in a manufactured shape to the most distant parts of the world; or as if the collieries, iron mines, and potteries of the heart of England were scattered along its shores. Peculiar local advantages will figure less than they have done in our manufacturing and commercial history, since whatever one place produces, can be as quickly and cheaply transported to another; and instead of our manufactures continuing concentrated in two or three large towns—to the great injury of the moral and physical condition of those employed in them—we may expect to see them spreading gradually over the whole kingdom. *Living in the country*, will no longer be a term synonymous with every sort of inconvenience; and it will come to be a mere matter of choice, whether a man of business lives close by his counting-house, or thirty miles from it. The rents of land and houses will not be raised by the change, but they will be equalized; they will be reduced in town and raised in the country. In proportion, too, as the intercourse of men with each other, and the interchange of commodities between them is thus facilitated, the greater will be the cheapness of every thing; the more our manufacturers will have it in their power to bear up against that foreign competition, by which they are so much endangered. The oftener (to use a common phrase) the penny is turned, the greater the profit; and the quicker a trader's returns, the smaller the capital he requires in business. In fine, we may say of railways, in general, as a worthy gentleman is said to have observed of the Stockton and Darlington line, and with ten times greater probability of seeing our prophesy realized —"Let the country but make the rail-roads, and the rail-roads will make the country."

Wonderful as were the results which have suggested these observations, they were abundantly confirmed by the farther experiments which we now proceed to detail.

Second Day, 7th October.

"The Novelty" engine of Messrs. Braithwaite and Ericsson was this day tried with a load of three times its weight attached to it, or 11 tons, 5 cwt.; and it drew this with ease at the rate of 20¾ miles per hour: thus proving itself to be equally good for speed as for power. We took particular notice to-day of its power of consuming its own smoke, and did not any time observe the emission of the smallest particle from the chimney.

The weather now became wet, and

the rain were clogged with mud, which made it necessary to suspend the prosecution of the experiments before the day had half elapsed. The attendance of spectators this morning was by no means so numerous as on the preceding day; but there were few of those absent—the engineers, men of science, &c.—whose presence was most desirable.

Third Day, 8th October.

Before the commencement of the experiments to-day, it was announced that the judges on reconsidering the card of "Stipulations and Conditions" originally issued, and of which we gave the substance last week, had considered them so defective as to make it necessary to substitute the following:—

"TRIAL OF THE LOCOMOTIVE ENGINES.

LIVERPOOL AND MANCHESTER RAILWAY.

"*The following is the Ordeal which we have decided each Locomotive Engine shall undergo, in contending for the Premium of £500, at Rainhill.*

"The weight of the locomotive engine, with its full complement of water in the boiler, shall be ascertained at the weighing machine, by eight o'clock in the morning, and the load assigned to it shall be three times the weight thereof. The water in the boiler shall be cold, and there shall be no fuel in the fire-place. As much fuel shall be weighed, and as much water shall be measured and delivered into the tender-carriage, as the owner of the engine may consider sufficient for the supply of the engine for a journey of thirty-five miles. The fire in the boiler shall then be lighted, and the quantity of fuel consumed for getting up the steam shall be determined, and the time noted.

"The tender-carriage, with the fuel and water, shall be considered to be, and taken as a part of the load assigned to the engine.

"Those engines that carry their own fuel and water, shall be allowed a proportionate deduction from their load, according to the weight of the engine.

"The engine, with the carriages attached to it, shall be run by hand up to the starting-post; and as soon as the steam is got up to fifty pounds per square inch, the engine shall set out upon its journey.

"The distance the engine shall perform each trip, shall be one mile and three quarters each way, including one-eighth of a mile at each end for getting up the speed, and for stopping the train; by this means the engine with its load will travel one and a half mile each way at full speed.

"The engine shall make ten trips, which will be equal to a journey of thirty-five miles; thirty-miles whereof shall be performed at full speed, and the average rate of travelling shall not be less than ten miles per hour.

"As soon as the engine has performed this task, (which will be equal to the travelling from Liverpool to Manchester,) there shall be a fresh supply of fuel and water delivered to her; and as soon as she can be got ready to set out again, she shall go up to the starting-post, and make ten trips more, which will be equal to the journey from Manchester back again to Liverpool.

"The time of performing every trip shall be accurately noted, as well as the time occupied in getting ready to set out on the second journey.

"Should the engine not be enabled to take along with it sufficient fuel and water for the journey of ten trips, the time occupied in taking in a fresh supply of fuel and water, shall be considered and taken as a part of the time in performing the journey.

J. U. RASTRICK, Esq. Stourbridge, C. E.
NICHOLAS WOOD, Esq. Killingworth, C. E.
JOHN KENNEDY, Esq. Manchester.
} Judges.

"Liverpool, Oct. 6th, 1829."

We shall not go into a question which has been raised, as to the fairness of the judges making any alteration in the conditions originally promulgated. We have a perfect persuasion that they have no other desire than to ascertain, in the best manner possible, the relative powers of the competing engines, and shall not quarrel with them for any mere irregularity in the mode of their proceedings. The "new" appears to us to be also, on the whole, a "much amended" edition.

In the original "stipulations and conditions," it was first ordered, that the load attached to each engine should be three times the weight of the engine;" and then, that the load drawn should be equal to "twenty tons, including the tender and water-tank." To reconcile these contradictory stipulations, and to make provi-

tion for the case of an engine carrying (as Messrs. Braithwaite and Ericsson's does) its own fuel and water, and therefore not requiring any tender, the matter of weight was thus arranged in the new conditions: "The tender-carriage, with the fuel and water shall be considered to be, and taken as a part of the load assigned to the engine." And "those engines that carry their own fuel and water, shall be allowed a proportionate deduction from their load according to the weight of the engine." At first sight these seem very fair conditions; and we have no doubt the intention of them was to do equal justice to all parties. When attentively examined, however, they will be found to have this defect—that they serve to place the steam-carriage, which uses a great deal of water and fuel, on the same level with one which uses very little; though a diminution of fuel and water consumed, is one of the most important improvements which can be introduced into a locomotive engine. As the judges could have no other intention than to place all parties on equal terms, they would have done better simply to stipulate, that "the weight of each engine should be considered to consist of its entire working power; that is, of the whole of the machinery, and the whole of the materials necessary for putting it in motion." The matter would then have been placed on its only just basis; and there would have been no chance of any arithmetical mystification in the results.

Another alteration relates to the pressure of steam which was to be allowed. It was at first stipulated that "the pressure of steam in the boiler should not exceed 50 lbs. on the square inch;" but in the new conditions all that was required was, that "as soon as the steam is got up to 50 lbs. per square inch, the engine shall set out on its journey." We think this alteration was a very expedient one. We know not how the pressure could have been constantly kept at just 50 lbs.; and are quite sure that it would have been very unjust to withhold the prize from a competitor, because he might occasionally exceed that maximum.

Nothing was said in the new conditions as to each engine's "effectually consuming its own smoke;" but this omission could only have arisen from oversight; for the Act of Parliament, under the authority of which the railway has been formed, orders imperatively that no engine shall be suffered to ply upon it which does not possess this qualification.

Having set these preliminary matters to right, we now proceed with our narrative of the experiments.

The engine which exhibited on this the third day was "The Rocket" of Mr. Stephenson. The trial was conducted in the manner laid down in the "Ordeal" we have just quoted; and it was understood on all hands that this trial should be considered decisive of its merits.

The engine, with its complement of water in the boiler, weighed 4 tons 5 cwt. and the load attached to it was 12 tons 15 cwt., or including a few persons who rode, about 13 tons. The journey was 1¾ mile each way, with an additional length of 220 yards at each end to stop the engine in, making in one journey 3¾ miles. The first experiment was for 35 miles, which is exactly 10 journeys, and, including all the stoppages at the ends, was performed in 3 hours and 10 minutes, being upwards of 11 miles an hour. After this a fresh supply of water was taken in, which occupied 16 minutes, when the engine again started, and ran 35 miles in 2 hours and 52 minutes, which is upwards of 12 miles an hour, including all stoppages. The speed of the engine, with its load, when in full motion, was, at different times, 13, 13½, 14, and 16 miles an hour; and, had the whole distance been in one continued direction, there is little doubt but the result would have been 15 miles an hour. The consumption of coke was on an average about half a ton in the 70 miles.

Fourth Day, 9th October.

To-day a public notice appeared from Messrs. Braithwaite and Ericsson, stating, that in consequence of the alterations made in the conditions of the competition, the trial of their engine in the manner prescribed by

no new "Ordeal," had, with the approbation of the judges, been deferred till the following day. The 9th became thus a *dies non* in the competition.

Fifth Day, 10th October.

At the appointed hour this morning "The Novelty" was weighed, and three times its weight assigned to it by the judges. The steam was got up in 54 minutes from the time of lighting the fire. The engine then went one trip by way of rehearsal, when a small pipe accidentally gave way, and it was found necessary to send to Prescot, a distance of two miles, to have it repaired.*

In the interval, Mr. Stephenson's locomotive engine was run twice down the course and back, making in all 7 miles, but with the whole load taken off from behind, including even the tender-carriage with the water-tank and fuel. Thus *stripped for the race*, "The Rocket" performed the seven miles in the space of 14 minutes 14 seconds, being at the rate of 30 miles an hour! This was a rate of speed nearly equal to the utmost which "The Novelty" had achieved; but as it carried with it neither fuel nor water, it is not a speed which it could have long sustained.

"The Novelty," having now had its broken pipe repaired, made several trips, but solely for the gratification of the spectators, who were to-day extremely numerous, and not with any view to a decisive exhibition of its powers. Mr. Vignoles, the engineer, who rode on the engine, and timed it during two of these trips, has favoured us with the following statement of its performances:—

* Things should have been better ordered. In any future competition, we would recommend that there should be a forge at hand, with all the necessary tools and materials, for repairing instantly any accident of this sort.

	Tons.	cwt.	qrs.	lbs.
Weight of the engine, as ascertained from Pickford's receipt for its carriage per canal from Liverpool	2	15	0	0
Water in the boiler, 45 gallons of 282 cubic inches, say 10 lbs. per gallon	0	4	0	2
Weight of the water-tank and stays	0	2	2	0
Water in the tank, 20 cubic feet, at 62lbs.	0	11	0	12
Coke baskets and sacks	0	0	0	20
Four bushels of coke at 42lbs.	0	1	2	0
Total weight of working power, including its complement of fuel and water	3	14	1	0
Persons on the engine—Mr. J. Braithwaite, 10½ stone, Capt. Ericsson, 12 stone, and Engine-man, 12 stone	0	4	0	10
Persons on the waggons—Mr. Vignoles, 9 stone, Mr. A. Braithwaite, 14 stone, Mr. S. Braithwaite, 13 stone, and Mr. Cooper, 11½ stone	0	5	8	21
Load assigned by the judges	6	2	0	0
Total weight of the engine and load	10	6	1	0

The engine was brought up near the starting-post a few minutes before three o'clock; and the rate of its speed, loaded as above detailed, is recorded in the following tables, in which the time indicates the moment of her passing each post. The distance between posts 1 and 2, and between posts 8 and 9, is only one furlong, (220 yards,) being the space allowed to acquire and check the engine's velocity, after and previous to turning; the distance between all the other posts is precisely a quarter of a mile (440 yards.)

EASTWARD TRIP.

H.	M.	S.		Strokes per minute.
2	59	16—starting-post	1	
2	59	51—judges' tent	2	120
3	0	50—bridge mark	3	
3	1	36—grand-stand post	4	140
3	2	22—quarter post	5	
3	3	5—quarter post	6	140
3	3	47—10-mile post	7	
3	4	30—judges' post	8	142
3	4	57—turning post	9	

Pressure always under 50lbs. per square inch.

The engine went off from the starting-post at the rate of 12 miles an hour, and her velocity rapidly increased during the whole trip.

By the above tables it will be seen, that the distance between the 9 and 10 mile marks was performed in 3 minutes and 7 seconds, and the mile between the quarter post, near the grand-stand and the judges' tent at the eastern end of the course, was run in 2 minutes and 54 seconds, while the last half mile was performed in 85 seconds, being at the rate of 21 1-6th miles per hour. The whole time between the tents of the judges at each end, being exactly 1¼ mile, was performed in 4 minutes and 39 seconds, being at the rate of 17½ miles per hour.

The gentleman at the brake of the wheel not being sufficiently experienced, the engine was not checked so soon as it ought to have been on the return, and went beyond the level part of the road, not being stopped until it had got some yards down the eastern inclined plane; upwards of 2½ minutes were lost in consequence. On returning, the following was the record of the

WESTWARD TRIP.

H.	M.	S.		Strokes per minute.
3	8	7—starting-post	9	
3	8	49—judges' tent	8	110
3	9	50—10-mile post	7	
3	10	49—quarter post	6	110
3	11	49—quarter post	5	
3	12	49—grand-stand post	4	110
3	13	17—bridge mark	3	
3	14	43—judges' tent	2	110
3	15	28—starting post	1	

Pressure always under 50lbs. per square inch.

The following calculation, founded on the preceding results, was made by Mr. Vigneles and Mr. Price of Neath Abbey:—

"The maximum number of strokes was 142 per minute, while 440 yards were traversed in 43 seconds. Diameter of wheels, 50·1 inches—circumference, 157·4 inches. 157·4×142 qual to 621 yards, being the velocity er minute of the circumference of heel, or 21 miles and 300 yards per ur. Then as 60 seconds: 621 yards :: 43 seconds: 445 yards."

Thus the calculated distance of the un (considering the wheel as a perambulator) agrees within 5 yards with the space actually passed over; and this difference might arise from the most trifling inaccuracy of noting the time—a quarter of a second at each end being sufficient to produce this discrepancy; so that it may fairly be concluded, that there was no slipping of the wheels at a velocity of nearly 22 miles an hour with a load.

Another carriage, with seats for the accommodation of passengers, was now substituted for the loaded waggons attached to "The Novelty," and about forty-five ladies and gentlemen ascended to enjoy the great novelty of a ride by steam. We can say for ourselves that we never enjoyed any thing in the way of travelling more. We flew along at the rate of a mile and a half in three minutes; and though the velocity was such, that we could scarcely distinguish objects as we passed by them, the motion was so steady and equable, that we could manage not only to read, but write.

Sixth Day, 13th October.

Mr. Aveworth's engine, "The Sans Pareil," was pronounced to be this day ready to exhibit its powers. We were informed that, on weighing it, the judges found it to exceed by two or three hundred-weight the maximum of six tons; it was, nevertheless, allowed to start to do 70 miles, in the same manner as "The Rocket," with three times its gross weight attached to it—that is, upwards of 1800 tons. It was soon manifest that a very powerful competitor had entered the field. For two hours "The Sans Pareil" kept going with great regularity, and during that time completed upwards of 26 miles. It went occasionally, when at its utmost speed, a mile in 4' 10" and 4' 17", being at the rate of nearly 15 miles an hour. While thus bidding fair—if not to win the prize, at least to come in second best—a similar accident happened to it as befel "The Novelty;" one of the feed pipes burst, and it was rendered for the time incapable of proceeding.

We understand the judges subsequently resolved that "The Sans Pareil" should have another trial on Friday, the 16th.

Seventh Day, 14th October.

It being generally understood that this was to be the day of a more decisive trial of Messrs. Braithwaite and Ericsson's engine—that is, according to the new conditions named by the judges—there was almost as numerous an assemblage of spectators as on the first day of the competition.

A fresh pipe had, it appeared, been substituted for the one which failed on the preceding trial; one or two other parts of the machinery that were in a faulty state, had also been renovated; but the engine, with the exception of some of the flanges of the boiler being as Mr. Ericsson expressed it, rather *green*, was pronounced in a working state. The load assigned to it by the judges was thus calculated:

	Tons.	*cwts.*	*qrs.*	*lbs.*
Weight of the engine, without any water or fuel . . .	2	15	0	0
Deduct for weight of tank and coke-baskets, and the quantity of water and fuel deemed necessary for a journey of 35 miles	0	16	1	9
Nett weight of "The Novelty's" working power, exclusive of the water and fuel, tank, &c	1	18	2	19
× by				3
Given weight to be drawn, dropping the fractional parts	5	16	0	0

The steam was on this occasion got up to a pressure of 50lbs. in somewhat less than 40 minutes, and at an expenditure of about 15lbs. of coke.

The engine now started to do the 70 miles for a continuance; but just as it had completed its second trip of three miles, when it was working at the rate of 15 miles an hour, the new cement of some of the flanges of the boiler, yielded to the high temperature to which it was exposed,* and the spectators had again the mortification to hear it announced that it was, under these circumstances, impossible the trial could go on.

Mr. Burstall's engine, "The Perseverance," which had met with an injurious accident on its way to Liverpool, but been since repaired, was now allowed to make some experimental trials. We left it returning from a third or fourth trip; but if we

* The Liverpool correspondent of the *Times* states, in a communication in Friday's paper, that "the pressure of the steam was too great for the boiler, which burst," and that this was the cause of the trial being put an end to. The real cause was literally as we have stated it to be, the yielding of the cement which secured several of the flanges; and next week we shall, by means of a diagram, explain this more particularly. We were close to the engine when it stopped, and can state of our own knowledge that no bursting of the boiler took place

may judge from the degree of speed which it then exhibited—not more, certainly, than five miles an hour—it has no chance.

We were informed that, early on Wednesday morning, before we reached the course, an experiment had been made with Mr. Stephenson's engine on a part of the railway which runs with an inclination of 1 in 96, and that it drew up this plane a carriage containing 25 passengers, with great ease.

[This narrative brings the proceedings down to three o'clock on Wednesday last. The conclusion of them we hope to be able to give in our next.]

Description of the Competing Engines.

1. THE NOVELTY.

We describe this engine first, not with any design of anticipating the award of the judges, but simply because it stands first in the official list of the "Running Coaches."

The external view of "The Novelty," given in the front page of our present Number, will at once satisfy our readers, that it has not been unmeritedly extolled by all who have seen it, for its singular lightness, elegance, and compactness. All locomotive engines have been hitherto so constructed, as to require a separate tender to carry the water and fuel necessary for these operations (we cannot as yet except Mr. Gurney's); but "The Novelty" includes within itself every necessary accommodation for these purposes, and is, nevertheless, much lighter than any engine on the old plan. "The Rocket" of Mr. Stephenson, which is one requiring a separate tender, weighs 4 tons 3 cwt., while "The Novelty" weighs only 2 tons 15 cwt.; making a difference in favour of the latter of 1 ton 8 cwt.

There have been people so absurd as to say there can be nothing gained by so great a reduction in the weight of an engine as this; that it is "something like substituting a Scotch galloway for a good team-horse, because the lighter the engines are the weaker." We do not dispute that there is a limit beyond which there is nothing to be gained by lessening the weight of an engine; but we think the performances of "The Novelty" furnish abundant proof that this engine at least has not approximated to that limit. The plan besides which the judges adopted of requiring that each engine should draw *three times its own weight*, was calculated to prevent most effectually any delusion on this head.

The advantage gained by such a reduction in weight as "The Novelty" exhibits, is one of no small moment. On the Stockton and Darlington Railway, the enormous weight of the engines employed (12 tons, we believe) has been a subject of great complaint. "The speed of the engines," says a writer on rail-roads,* "has been increased on the Darlington road, by substituting wheels of 4 feet diameter instead of 3; but these working upon the plain bars cannot be case-hardened, for fear they should turn round when they have a hard pull—consequently, they are cast of soft iron, which from the immense weight of the engines, *wears into grooves*, the width of the rails, and with the heavy drag, bites upon the rails, and twists them sideways, which keeps men incessantly upon the line setting them straight: the proof is obvious, because where the *engines* do not work, but the *waggons only*, the rails keep their position, and want no repairs."

The Directors of the Liverpool and Manchester Railway having the experience of these results before them, very wisely made superior lightness, one of the foremost qualifications, which should enable an engine to be ranked as "the most improved" of those competing for the prize. They announced that "the weight of the machine, with its complement of water in the boiler, must at most *not exceed* 6 *tons*, and that a machine of *less* weight will be preferred if it drew after it a *proportionate* weight."

The means by which the inventors of "The Novelty" have been able to combine so much lightness with great

* A Treatise on the Utility of a Railway from Leeds to Selby and Hull, &c. By Thomas Hill.

power, will be unfolded as we proceed with our description.

The engraving on our front page exhibits the external elevation of the engine. F is the carriage-frame; E the end of a circular boiler which passes under the carriage frame towards the steam-chamber A; L a hopper to receive the fuel, (which is carried in two small baskets placed on the frame) whence it falls through a pipe in the centre of the steam-chamber A, into the furnace S; M the ash pit; D and N two working cylinders and their slides (one of each only is seen in the engraving); B the water-tank; C an air-compressing apparatus, which acts on the furnace through the medium of a pipe that passes under the fire-work, and ends at K; N a pipe for the escape of the heated air; O G the connecting rods which impart the action of the pistons to the wheels.

The boiler is made to contain about 45 gallons of water; the diameter of each of the cylinders is 6 inches, and the length of the stroke 12.

The engraving on the second page of this week's Number, is intended to explain more particularly a very beautiful arrangement of the springs, to which this engine is mainly indebted for its superior steadiness when in motion. The axle-trees are fixed to the iron rod A, and a sling C is introduced to obviate that side action which would otherwise take place between the rod and the carriage-frame B. Again, to prevent the action of the springs from interfering with the action of the engine, the connecting rod, D, is placed as nearly in a horizontal position as possible; the connecting rods are moved by bell-cranks, E, which are connected by slings, F, with the piston rod. The springs, by the way, are of singularly excellent manufacture; they were made by Thrupp, and fully justify the celebrity which he has acquired in this peculiar branch of art.

The wheels are of the excellent description patented by Messrs. Jones and Co.,* and the choice of them by Messrs. Braithwaite and Ericson is as strong a tribute as could well have been paid to their merits. From the peculiar manner of their construction they act with the least possible interference from the weight of the engine, and being perfectly cylindrical, bear equally with their whole breadth on the rails. The lightness for which these wheels are famed, is not in this instance so remarkable; "The Novelty" being itself in its main parts so light, as to throw other things in comparison with it into the shade. Of the total weight of 2 tons 15 cwt., we believe 18 cwt. falls to the share of the wheels.

[To be continued in our next; when we shall complete our account of "The Novelty," describe one or more of the other engines, and add some general remarks.]

* For a particular description of Messrs. Jones and Co.'s wheels, the reader may consult our 245th number.

DIALLING.

Sir,—Observing in your September Part (1827) some questions in dialling by "J. G." which have not I believe been yet answered, I take the liberty of sending the following sketch of the fundamental principles of the art, which, as it is altogether new, and contains sufficient to solve all those questions, may not be deemed unworthy a place in the valuable pages of the Mechanics' Magazine.

Sketch of the Fundamental Principles of Dialling.

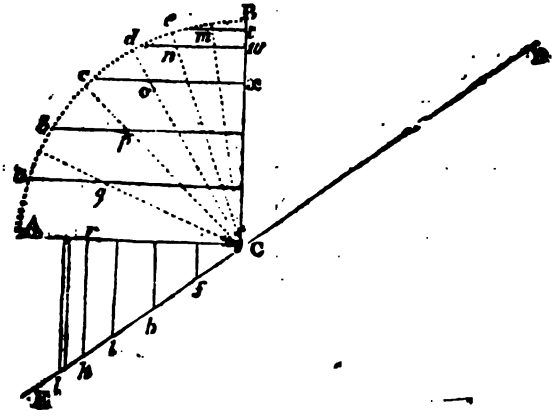
The equator may be considered the plane of a dial, and the stereographic projection of the meridians upon the equator will give 24 hour lines; and if the earth be supposed transparent and the axis opaque, when the sun comes upon the plane of any of these meridians, the shadow of the axis will fall on the opposite meridian; and so of the rest as the sun comes upon the plane of each of the meridians in succession, the shadow of the axis will fall on the opposite side.

Hence to construct an equatorial dial, nothing more is necessary than to divide its plane into 24 equal parts by lines divergent from the centre, fixing the axis perpendicular to the plane, and putting the names of the hours to their proper lines, and erecting the plane to an angle equal to

the co-latitude of the place. There can be no sensible error in this construction, for the distance from the centre to the surface of the earth is but as a point compared with the distance of the earth from the sun.

But if a plane pass obliquely to the equator through the centre of the earth, or parallel to the horizon of some place not on the equator, i circumference will always be cut unequally by the meridians (1); and the axis will make with the plane an angle equal to the complement of its angle with the equator at the centre. Now the difficulty of this art lies principally in finding these points; on the circumference from which to the point where the axis is fixed, lines being drawn shall be the hour lines.

Now when a plane is supposed to pass through the equator, and to incline in any angle to its surface, it is obvious from the consideration of the sections of planes, that *if from the points where the meridians cut the circumference of the equatorial plane, lines be drawn perpendicularly to the oblique plane, the points where these lines cut the oblique plane being joined to the centre will give the true hour lines on the oblique plane*; or otherwise, if from the points where the meridians cut the circumference of the oblique plane, lines be drawn upon the equatorial plane perpendicularly to its surface, they will fall upon the hour lines at equal distances from each other. Upon a plane surface the lines on the oblique plane are easily found by an orthographic projection.



In the above figure, if ABC represent a quadrant of the equator, C the centre, and *a*, *b*, *c*, *d*, *e*, points where the hour lines meet the circumference, the points *m*, *n*, *o*, *p*, *q*, will be points found by the method of orthographic projection, through which from the centre the hour lines will pass for a plane, making with the equator an angle equal to BCD; or they are the same as would be found by drawing from the points *a*, *b*, &c. on the equator lines perpendicular to an oblique plane, making with the equator an angle equal to the angle BCD.

The points *m*, *n*, *o*, *p*, *q*, are found as follows:—from *a*, *b*, *c*, *d*, *e*, draw perpendiculars upon BC; produce DC to E, and upon CE transfer the distances *et*, *dw*, *cx*, &c. to the points *f*, *g*, *h*, &c., and from *f*, *g*, *h*, &c. draw perpendiculars upon AC; transfer these perpendiculars along *et*, *dw*, &c. to the points *m*, *n*, &c., and they will be points through which the hour lines for the oblique plane will pass.

The above observations contain all the general principles of the construction of dials, and will be found sufficient to an ingenious mind for the construction of all sorts of dials.

If the dial is to be vertical for a given latitude, its axis must evidently (from what has been said) make with

its plane an angle equal to the co-latitude (2); and this, being done upon the plane, the hour lines are to be found by the orthographic projection in the manner explained.

And it may be remarked that, if the surface of the dial be curved, the axis must have the same position as if it were a plane, and the hour lines must be traced over the curve surface from the extremities of their delineations upon the plane.

These remarks enable us to proceed immediately to the solution of "J. C.'s" questions. And it is evident,

(1.) That the positions of the hour lines will be different on dials having the same degree of obliquity for different latitudes.

(2.) That the axis of a vertical dial must make with its plane an angle equal to the co-latitude of the place.

(3.) That the axis of an east or west dial must be parallel to its plane.

(4.) If a dial decline or recline from the east or west, its axis (parallel to the axis of the earth) can no longer be parallel to its surface: therefore any alteration in the position of the same plane with the same index will produce a corresponding alteration in the time.

(5.) The enunciation of the fifth question is absurd; for the plane of an east or west dial at the equator will not be parallel to it, but perpendicular or parallel to the axis.

(6.) If an east or west dial be inclined in any angle to the horizon, it can no longer be an east or west dial, and therefore will not be cut in the same points by the meridians; consequently the hour lines will be differently posited, that is to say, this inclination will alter the time shown.

Aug. 26, 1829. B.

MISCELLANEOUS.

Price of Calico Fifty-three Years ago.—The following memorandum was written in a Bible, now in the possession of a family at Rishton, near Blackburn, for the purpose, no doubt, of recording the period when the manufacture of calico was first introduced into this country.—"15 September, 1776. Thomas Dixbury, of Rishton, near Blackburn, sold to Messrs. Peels, Yates, and Co. Church Bank, two common fine calico pieces for £3. 9s. 6d. These were the first calico pieces ever manufactured in this kingdom." Pieces of the same description are now sold for about 5s. 6d. or 6s. each

New Sheathing for Ships.—It is stated in accounts from Van Diemen's Land, that a [illegible] is now building there of teak [illegible] to be sheathed with sheets of India rubber, which it is supposed will be not only impervious to water, but wholly free from any tendency to foulness or corrosion.

Ocean Wood is the name of a new species of wood which has been lately used by Mr. Tomkison, in the manufacture of piano-fortes. It is a sort of mahogany, and its name is supposed to have been given, from a fancied resemblance its grain presents to the undulation of the sea. It is quite an unique in the English market, and for a single log Mr. Tomkison is said to have paid the enormous sum of 2300 guineas.

Painting on Glass.—The Count de Nieuwerkerke, a native of France, [illegible] to Lord Prudhoe, of painting on glass, which equals the [illegible] discovered method of the ancients. Four [illegible] which have been lately painted by him and [illegible] one of them for the chapel at the Luxembourg, are spoken of in terms of great praise by the Parisian critics.

The Art of Interweaving Figures on Cloth, by varying the arrangement of the warp, appears to have been early practised by the Egyptians. Herodotus (lib. iii. c. 47.) mentions a linen cuirass or breast-plate, sent by King Amasis to the Lacedæmonians, with many figures of animals woven into it; adding, as a thing extraordinary, that each thread of it, though apparently slender, was composed of *three hundred* threads, all distinctly visible.

An Air Spout.—On the 15th ult. an extraordinary phenomenon presented itself at Gorschef in the Russian government of Pskow. Under a cloudy but tranquil sky, a violent whirlwind, accompanied by hail and a roaring noise, suddenly arose, and, passing over the town, completely devastated whatever it met in its passage, for a breadth of about eighty yards. Several buildings were totally destroyed, and others unroofed. Large trees were torn up by the roots, and carried to the distance of ten versts. A considerable number of persons lost their lives, and a great quantity of cattle perished. In the other parts of the town every thing was perfectly calm, not a single bough being shaken.

Preservation of Peach Trees.—A writer in the *Southern Patriot* proposes, as a way to prevent worms from injuring the trunks of peach trees, that a quantity of clay or compost be heaped round the roots, mixed with a little lime, marsh, or mud, while they are in the wood, that they may be suffocated before the fly can escape.

INTERIM NOTICES.

Communications received from D. C.—Mr. Baddeley—Q.—Philo Mechanicus—A West-Countryman—S. P. W.—Mr. Greenal—H. Geer—A Constant Reader—John O'Groat—A. C. R.—W. W.—A Young Beginner—Millvil Thigah—T.—X.—Omicron—G. P.—G. A. E.—Mr. Franklin.

More particular acknowledgments in our next.

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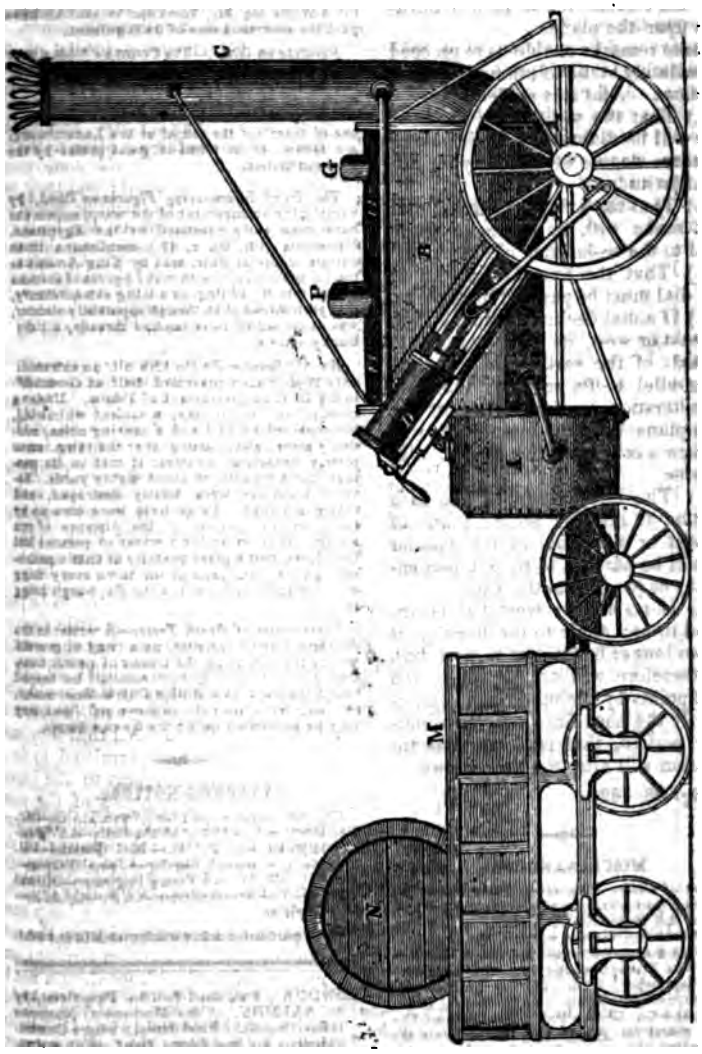
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 324.] SATURDAY, OCTOBER 24, 1829. [Price 3d.

"THE ROCKET," LOCOMOTIVE STEAM ENGINE OF MR. ROBERT STEPHENSON.



COMPETITION OF LOCOMOTIVE CARRIAGES ON THE LIVERPOOL AND MANCHESTER RAILWAY.

(Continued from our last Number.)

Seventh Day, 14th October.

It appears that after we left the railway on Wednesday se'nnight, and took our departure for town, Messrs. Braithwaite and Ericsson intimated to the judges, that as the joints of "The Novelty" which had given way, could not be restored to a working state before the lapse of at least eight days, and the prolongation of the competition was likely to be attended with great inconvenience to many parties, they would withdraw their engine from any further trial, and "leave it to be judged of by the performances it had already exhibited." The manner in which this virtual conclusion to the proceedings has been announced by one of the Liverpool papers, is so distinguished by its fairness and liberality, that we cannot deny ourselves the pleasure of making the following quotation from it on the subject:—

(From the Liverpool Mercury.)

"We may consider the trial of the Locomotive Engines as now virtually at an end. It is much to be regretted, that 'The Novelty' was not built in time to have the same opportunity of exercising that Mr. Stephenson's engine had, or that there is not in London, or its vicinity, any railway where experiments with it could have been tried. It will evidently require several weeks to perfect the working of the machine and the proper fitting of the joints, and under this impression, Messrs. Braithwaite and Ericsson have acted wisely in withdrawing, as they have done, from the contest.

"The course is thus left clear for Mr. Stephenson; and we congratulate him, with much sincerity, on the probability of his being about to receive the reward of £500. This is due to him for the perfection to which he has brought the old-fashioned locomotive engine; but the *grand prize of public opinion* is the one which has been gained by Messrs. Braithwaite and Ericsson, for their decided improvement in the arrangement, the safety, simplicity, and the smoothness and steadiness of a locomotive engine; and however imperfect the present works of the machine may be, it is beyond a doubt—and we believe we speak the opinion of nine-tenths of the engineers and scientific men now in Liverpool—that it is the principle and arrangement of this London engine which will be followed in the construction of all future locomotives. The powerful introduction of a blast bellows, the position of the water-tank below the body of the carriage, by which means the centre of gravity is brought below the line of central motion, the beautiful mechanism of the connecting movement of the wheels, the absolute absence of all smell, smoke, noise, vibration, or unpleasant feeling of any kind, the elegance of the machinery, in short the *tout ensemble* proclaim the perfection of the principle.

"In withdrawing so honourably from the competition, Messrs. Braithwaite and Ericsson have done themselves the highest credit; and they may rest assured that the scientific world will do justice to their efforts, and look with anxiety to a speedy completion of their elegant and compact engine prepared to bear the fiercest 'ordeal' which the judges may please to direct."

"The Novelty" still remains at Liverpool, and Messrs. Braithwaite and Ericsson have publicly announced that as soon as it is repaired, and the cement of the joints sufficiently hardened, they will (with the leave of the Directors) complete the exhibition of its powers; and show that but for the accidents which it unfortunately met with, it was more than equal to the accomplishment of the task that was last assigned to it.

The prize is not expected to be positively awarded for some little time yet to come. It appears that the gentlemen who were appointed to act as *judges*, have had only the name and not the usual powers of *judges* conferred upon them. All that they have been required and permitted to do is to make an exact report to the Directors of the performances of the competing engines; the Directors reserving to themselves the power of deciding which is best entitled to the premium. From the manner in which such reserved powers have been exercised in other cases (witness the conduct of the New London Bridge Committee to Mr. Gwilt), we should not be inclined to indulge in any favourable anticipations on the present occasion; but it so happens, that this competition has taken a course which makes

ult for the Directors to go far in their decision. What *all* were by which the comparaits of the competing engines be tried, it would be hard to either the original "Conditional Stipulations," nor the "Orwhich was subsequently subin their place, being separconsidered, sufficiently full plicit on the subject; but this certain, that the performance sixty miles, for a continuance, criterion of excellence to all the competitors expressed a submission. "The Rocket" on this understanding; and ed the distance at a rate of which, *for a continuance*, stands unrivalled in the annals of railing. "The Sans Pareil' ade the attempt; but in consepart of its machinery giving nly performed about half the e. "The Novelty" followed; scarcely started, when it was t by a similar accident to a ind. Now, though we are of that "The Novelty" is the engine that will be found best d to the purposes of the railand are inclined to think that Sans Pareil" is at least as good ine as "The Rocket;" yet as the one nor the other has d "The Rocket" in a perce, which had the winning of e of £500 expressly for its obe do not see how the Directors justice do otherwise than award rize to Mr. Stephenson. Bewhatever may be the merits of Rocket," as contrasted with of its rivals, it is so much suto all the old locomotive enin use, as to entitle Mr. Steon to the most marked and hconsideration, for the skill and ity displayed in its construcIf a Parliamentary reward of mount was justly conferred on on, for being the first to bring instrument of time within certained limits of accuracy—or on for penetrating to a higher deof northern latitude than any ing navigator—the Directors of erpool and Manchester Railmust do wrong in awarding to Mr. Stephenson a premium of £500 for producing an engine which has done what no locomotive engine ever before accomplished—gone seventy miles continuously, at an average rate of about twelve miles an hour, with a load of three times its weight attached to it: which has realized a degree of speed and power, which, though much desired, had scarcely been anticipated even by the most sanguine. As the timekeeper of Harrison has been excelled by others of more recent construction—and new discovery ships may be expected to penetrate still further than the Hecla and Fury —so may "The Rocket" be eclipsed by other locomotive engines, by the very engines against which it tried its powers on the present occasion; but probable though this be—nay, almost a matter of certainty—there is merit enough in what Mr. Stephenson has thus far effected, to cause the reward of the premium to him to be regarded with unmixed satisfaction by the whole scientific world.

The Proprietors of the Liverpool and Manchester Railway would be no losers were they to grant a liberal indemnity to the competitors, one and all, for the trouble and expense which they have incurred on the occasion. Such has been the good effect of this competition on the public mind, that the selling price of the Company's shares has advanced no less than 10 per cent. since the day on which it commenced. Now, 10 per cent. on a total capital of £650,000, makes the nett sum gained by this judicious scheme of competition, no less than £65,000; minus the £500 premium, and any further sum which may be awarded in gratuities to the unsuccessful competitors.

The account which we gave in our last Number of the origin of this undertaking, was, it seems, erroneous in one or two particulars. For the following more correct statement we are indebted to a gentleman intimately acquainted with all the circumstances of the case:—

"The railway was first projected by Mr. William James, who surveyed his own line, which ran very much on the level of the country, and had many turns and different inclinations. It was

after the return of the Liverpool Deputation from the north, that Mr. George Stephenson was engaged to lay out another line, which was in a very different direction from that of Mr. James, and went on a different principle as respects the inclinations. With this line the Directors went to Parliament, and the Bill was lost, partly through the opposition of the canal proprietors, but principally from the great errors of the levels, which in some parts were erroneous, *to the extent of forty feet!* This fact is notorious, and will be well remembered by all those who attended to the parliamentary proceedings in 1825. It was in consequence of this, that the Directors engaged Messrs. Rennie, who immediately sent down Mr. Vignoles; and it was not until that engineer had explored the country between Liverpool and Manchester for several months, that the present line of the Railway was determined on, differing totally from the routes surveyed by Mr. James and by Mr. Stephenson, being some miles shorter than either, in fact only 31 miles from the Liverpool Docks to the River Irwell, at Manchester, and not 33, which was the length of Mr. Stephenson's line. In adopting the present line, the entrance into Liverpool by the tunnel, was for the first time projected; the route through the deep cuttings was changed from a slippery clay country, to the red sand stone rock district: the passage of the Sankey Valley and Newton Brook, by the present immense bridges was planned; and a totally different character given to the line in general. On the second application to the legislature, the Bill passed after a desperate struggle in both Houses of Parliament; but when the question of executing the work came to be discussed, the Directors and Messrs. Rennie did not agree, and Mr. Stephenson was called upon to lay down the railway on the line surveyed by Mr. Vignoles."

We took a passing glance in our last Number at the beneficial effects which would result from the extension of this system of communication over the whole kingdom. A writer in the *Times* has since offered some judicious suggestions on this head, which we shall take the liberty of transferring to our pages:—

"It certainly is with propriety that a correspondent of the *Times*, of Friday, Oct. 9th, has reminded the public that it is only on the hard and even surface of an iron railway, the wheels of a locomotive engine can run with proper effect. But there is another mode of introducing the non-public roads, which is extremely simple and economical; and one which, ere long, it requires little sagacity to predict, will be successfully introduced; viz. the laying down railways by the side of our turnpike-roads, on which locomotive engines can travel. A common stage coach, weighing, when fully loaded, one or two tons, is now drawn on a road by four horses, at the speed of 9 or 10 miles an hour, but could be conveyed at the rate of 20 miles an hour along a railway, following the undulating surface of a turnpike-road, whose inequalities were not very considerable. It is true that coaches could not travel up the steepest ascents with a load at a velocity equal to what might be effected along such a line as the Manchester and Liverpool Railway; but they would double the present speed and load, in conveying passengers and light goods at a comparative expense, which would be as a quarter of a cwt. of coals is to one day's keep of a horse, the capital being as the cost and wear and tear of one locomotive engine is to the cost and tear of 50 horses; the carriages being the same in both cases.

"It is therefore nothing problematical to expect in the course of the next ten years to see railways established by turnpike-roads from London, Liverpool, Hull, Edinburgh, &c. &c. &c. in every direction, each set of road-trustees bearing the cost of their own length of railway, (say £3000 per mile,) all under some general system. Many objections may be made to this idea, of which those resting on the inclination of the roads, the sharpness of the turns, and the liability of the rails to casual obstruction, are the only ones worth serious attention. But more than one engineer, well conversant with railways, has spoken confidently of easily obviating all these, by perfecting the locomotive engine and its appendages, by occasional alteration of the lines and levels of the roads, by slight lateral frames, and by other expedients which experience will point out.

"On railways laid down upon the high road from London to Liverpool, the mails drawn by a slight locomotive carriage might travel the distance, 204 miles, with facility in 12 hours, carrying double their present complement of passengers, and this at a cost of fuel not exceeding 10s. or scarcely one halfpenny per mile, while 2¼d. per mile

would amply cover the interest of capital for engines, water, stations, &c.

"Much more might be said on this subject, which is now about to occupy the serious attention of many engineers and scientific men, and only wants the spur of wealthy patronage to break forth into something more than mere idle conjecture. In the mean time the experiment is well worth making; and the road-trustees from Liverpool to Manchester, who, between rail-roads and canals, will soon lose all their toll-payers, might set the example to the rest of the kingdom."

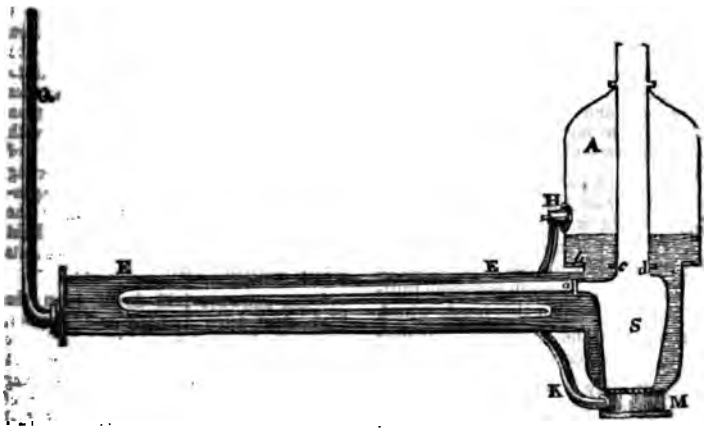
We do not believe there are many roads in the country on which railways might not be laid down on the plan here suggested with decided advantage. Wherever there is a greater rise than a locomotive engine could by its own power overcome, there might be stationary engines to help them forward; and any expense which might be incurred for such stationary engines, would be amply compensated by the vast saving effected, in laying down the railway on a road already made, and on ground already paid for.

But though the old turnpike-roads might be saved by this means from a ruinous competition, what shall be said of the fate that awaits canals? We shall not say with a facetious friend, that "the best thing the gentlemen of the canal interest can now do, is to fill up their canals and convert them into railways;" but we would seriously submit to them the propriety of adopting a course precisely similar to that recommended to the trustees of turnpike-roads. They have even still greater facilities for the purpose than these trustees. They are already in possession of all the best levels and some of the best lines of traffic in the country, and have only to lay down railways along the banks of their canals to combine together the peculiar advantages of both these modes of conveyance, canals and railways. There would be occasion for no more stationary engines than there are locks; and expedients might even be devised by which the latter might be made to serve in most cases all the purposes of the former.

[In our next we shall give a tabular view of the performances of the different engines, and offer some general remarks on the results which the present competition has furnished, with respect to the speed and economy of railway conveyance.]

DESCRIPTION OF THE COMPETING ENGINES.

Continued from page 142.



1. THE NOVELTY—*(Concluded).*

Having described the external appearance of *this engine, we now proceed to explain its interior construc*tion: for the better understanding of which, we present our readers with a rough, sectional view (drawn from recollection) of the more material parts.

S is the furnace, which is supplied with fuel from the hopper L (see the engraving in our last No.), through the vertical tube in the centre of the steam-chamber A; the heated air from this furnace passes off through a flue, which is made to wind twice or thrice up and down the cylinder EE, and gradually diminishes in diameter till its termination in the escape-pipe Q (called N by mistake in the description in our last Number). The parts shaded in the sketch are those occupied by the water, which, it will be observed, surrounds the boiler as well as the flue.

The extent of surface exposed to the action of the heat by this arrangement, is a great deal less than in other engines; and were the heat left to circulate as in other engines, through the agency of what is commonly called atmospheric draught merely, there would probably be nothing gained in respect of the quantity of steam generated. But instead of depending on the atmospheric draught, Messrs. Braithwaite and Ericsson make use of the bellows-sort of apparatus (C K), represented in the front elevation of the engine given in our last Number, to force the heated air through the flue; and by thus supplying a greater quantity of caloric in a given time, they obtain an effect precisely analogous to what would result from doubling or quadrupling the size of the furnace, and the extent of the flue. Nor is this all: the quantity of atmospheric air which is introduced under and through the fire by the pipe K, has not only the effect of forcing the heated air onwards through the flue, but is itself a source of heat—equivalent to the employment of so much additional coke. It is in these two circumstances—the acceleration of the draught and the supply of fuel (if we may so speak), derived from the atmosphere—that the great merit of "The Novelty"—the secret of its vast superiority—consists. It makes up by the quickness of its operations for the diminutiveness of its dimensions; by what it borrows from the air around it for the small supply of coke which it carries.

Neither does the rapidity with which the current of hot air passes through the flue constitute any exception to the efficiency of the process: for such is the aptitude of small circular pipes, like this, to abstract heat from any fluid conveyed through them, and to part with it again to surrounding substances, that little, if any, caloric is suffered to pass unappropriated.

The flue is made to diminish *gradually*, because the heated air cools in its passage through it, and gradually requires less and less vent. It has also a downward inclination given to it, as represented in the sketch—such, that if a marble ball were dropped in at the furnace end, it would roll rapidly through all the convolutions of the pipe to the other extremity; and the object of so constructing it is, that any dust which may arise from the furnace may have always a descending passage to escape by.

In the specification of the patent which Messrs. Braithwaite and Ericsson have taken out for this mode of generating steam, mention is made of two air-forcing pipes: one by which atmospheric air is forced on to the *top* of the fuel in the furnace; and another through which air is forced under the bottom of the fuel. A double supply of air, however, is only considered necessary where coal is the fuel employed, in order to ensure its combustion more effectually; and where fuel of the purity of coke is made use of, as in "The Novelty," the upper pipe is dispensed with.

There are, of course, cocks to regulate the transmission of air through the pipe K; also safety-valves to the boiler and steam-chamber; but these, as well as the feed-pump for supplying the water from the tank, have been left out in our sketches, as being unnecessary to illustrate the principle of the engine.

It is now fitting we should explain more particularly, than has yet been done, the cause of those accidents by which some doubt has been for the moment thrown on the soundness of that principle. The engine, it appears, had been got up in a hurry—having been begun and finished within the short space of the six weeks immediately preceding the competi-

tion—and had never been subjected to any sort of proof. It was not to be expected therefore that it should be found perfect at all points. The part which was first observed to perform its office insufficiently, was the pipe of the feed-pump; and the consequence was, that the water, which it is the business of this pump to keep always at the height marked in our sectional sketch, sunk below the level of the flue of the furnace; which flue being thus left exposed to a dry temperature of high elevation, gave way near to the flange *a*. In order to get at this damaged part of the flue, it was necessary to lift off the steam-chamber A, and for this purpose to undo the joints *b*, *c*, *d*, and *e*. To renovate the flue was an easy matter, but not so to restore the joints all at once to the state in which they previously were. The cement with which they were re-secured would have required a week at least to harden properly; but it was as yet scarce twelve hours' old when the engine started to perform the last task assigned to it. As might have been naturally expected, the joints yielded to the high temperature (300°) to which they were exposed; the steam began to escape at all points; and the efficiency of the engine was for the time and occasion, at an end.

The impartial reader will see nothing in any of these mischances tending in the least to discredit the principle on which "The Novelty" is constructed. It was not the peculiarity of that principle which caused either the defective feed-pipe to go wrong, or the unduly-exposed flue to crack, or the green joints to give way. The principle worked admirably, as long as every part of the machinery stood firm, and had fair play: nor can a doubt be reasonably entertained, that had the engine been previously proved (as cannon and muskets are proved), and been kept in good working order, it would upon the trial for a continuance have fully realized the expectations which its previous performances had excited. The grand point on which its superiority depends had already been fully established; namely, that it can generate a greater quantity of steam in a given time than was ever before produced by any apparatus of equal capacity. No further trial was wanted to show that what it could do for one hour in this respect, it would do for any number of hours. There might be errors committed in estimating the quantity of water and fuel requisite for a long journey, but there could be none in assuming that the power of the air-forcing pump to augment the heat and accelerate the circulation of the heated air, must of necessity remain the same, whether the journey is short or long. Every thing needful for the manifestation of the master principle of the engine had been done; and all that was left unaccomplished, was but such a practical display as might convince those who, unable to appreciate principles, look only to results.*

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†2. The Rocket.

The front page of our present Number exhibits an external elevation of this engine and its tender; but on a scale one-half less than our engraving of "The Novelty." The furnace A is two feet wide by three feet high; the boiler B is six feet long and three feet in diameter. The furnace, like that of "The Novelty," has an external casing, between which and the fire-plate there is a space of three inches filled with water, and communicating with the boiler. The heated air from the furnace is circulated through the boiler by means of twenty-five copper pipes of three inches each in diameter, which have their termination in the tall chimney C. FG are safety-valves; HH the steam-eduction pipe. D one of two steam cylinders which have an angular inclination

* In mentioning in our last Number the preference which Messrs. Braithwaite and Ericsson have given to the excellent wheels of Messrs. Jones and Co., we mentioned that they weighed 18 cwt. We have been since assured by the patentees, that their actual weight was only 13 cwt.

† "The Sans Pareil" stood second in the list of the competing engines, and should have been next described; but we have not been able to procure a drawing of it in time for this week's publication. We shall do it justice next week.

towards the wheels, and embrace like two arms the boiler between them. E one of the connecting-rods which give motion to the wheels; *a*, the slide of the piston of the cylinder seen in the engraving; and *o*, one of two escape-pipes. M is the part of the tender appropriated to the carriage of fuel; N the water-cask.

The performances of this engine indicate a very abundant and well-sustained production of steam; but the extent of surface which it has been found necessary to expose to the heat, in order to obtain that effect, the great size of all the parts, and the quantity of fuel required—are faults which even a still more copious generation of steam would scarcely compensate. It is not by means of its heavy weight alone that such an engine would operate injuriously on the rails. The chimney from its great height—a height necessary to obtain that draught which in "The Novelty" is produced by means of the air-forcing apparatus—gives a swaying motion to the engine from side to side; and the rails have thus a lateral as well as a longitudinal force applied to jerk them out of their places.

We observed in our first notice of this engine, (No. 322, p. 115) that it exhibited but a very partial fulfilment of the condition that it should "*effectually consume its own smoke.*" As far as regards its performances on the first day of the competition, this statement was perfectly correct. It is only fair however to state, that in its more recent exhibitions there was scarcely any emission of smoke perceptible. We have heard that on the first day there was an accidental intermixture of coal with the coke; a circumstance which, if true, would sufficiently account for the appearance of smoke on that occasion.

(To be continued in our next.)

RAIL-ROADS.

Sir,—Permit me, through the medium of your excellent publication, to suggest to your numerous readers the following alteration in the construction of railways, which are at this period so *much in vogue.*

The difference in the construction here proposed is to have the railways inverted (if I may be allowed the expression), that is, the wheels upon the ground and the rails upon the carriages. The wheels or rollers should be of small diameters, and of a proper breadth, moving upon axles of cast iron, and placed at certain distances in parallel lines similar to the present rails; the distance between each in a longitudinal direction to correspond with the length of the waggon, so that the carriage-rails may rest upon four or six of the wheels or rollers at one and the same time. If this mode be attended with less expense than the present roads, and as convenient, why not adopt it? Less iron will be required than for rails made upon the present system. It may be urged that the mode here suggested would only answer upon straight roads, but that may be obviated by a very simple piece of machinery, so that the carriages may travel along any curved or other circuitous rail-road whatever.

Merely giving this hint, which some of your scientific friends may improve upon, as the proposed alteration has not to my knowledge been thought of before,

I am, Sir, yours, &c.

W. B.

Oct. 18, 1829.

IMPROVEMENT IN BUILDING.

Sir,—An improvement in domestic architecture, the want of which has been long and severely felt, has been very judiciously introduced into the houses now building in the Strand, in lieu of those taken down in the course of the improvements which have taken place in that quarter. I allude to the change in the materials used for the brestsummers, which, as well as the supports, are strongly formed of cast iron. Upon the brestsummers is laid a course of Yorkshire paving-stone, about two inches in thickness. This admirable arrangement will completely secure the front of the buildings from the dry-rot, and from fire.

Many of your readers will doubtless remember numberless melancholy effects, which have resulted from the ravages of the latter, in buildings supported by brestsummers of wood. At the lamentable fire which occurred last May in the Lon-

don-road, six persons met an untimely end from this circumstance; the fire broke out on the ground-floor with great fury, and almost immediately burned the bressummers through: the consequence was, that the front of the house came down, within a few minutes after the discovery of the fire, before the inmates could escape, or those without could possibly render them assistance.

It is sincerely to be hoped that iron will in future be every where employed for this essential part of buildings; the increased stability will of itself more than make up for any trifling difference in expense.

Yours respectfully,

WM. BADDELEY, Jun.

Oct. 9, 1829.

MR. CHAPMAN'S SPECIMENS OF THE DIVISION OF THE ELLIPSIS.

Sir,—I see in a note you have appended to my communication respecting the division of the ellipsis, you state that my accompanying specimen is not correct. I agree that it is not so, and it would have been very odd if it had, considering the hasty and imperfect manner in which the apparatus was got up. For instance, one of the two principal wheels was an old one I had by me, which I gave to my moulder to cast a duplicate by, teeth and all. After he tried to mould it, the teeth being too parallel, would not strip the sand. I therefore gave him leave to file them sufficiently bevel, and they were no otherwise adjusted than by the file at chance. It could not, of course, be reasonably expected that the effects of the apparatus would be very correct. But that I think little about; it is the principle of the thing I contend for: not doubting that when time and inclination suit, I shall be able to produce the figure as correctly divided as any you have yet seen, or needs be.

I remain, sir, yours respectfully,

G. CHAPMAN.

[Our friend writes reproachfully, but surely without reason. We simply pointed attention to the fact that the division of the ellipsis was not correct in his specimen, and had no knowledge of the circumstances which he now mentions as accounting for that incorrectness.—EDIT.]

INSTRUMENTAL ARITHMETIC.

DESCRIPTION AND USE OF AN IMPROVED SLIDING-RULE, ADAPTED TO ALL PURPOSES OF COMMON ARITHMETIC*. BY THOMAS SADDINGTON.

(Continued from page 125.)

On the improved side are laid down double lines of decimal numbers, divided as on the other side, which are marked decimal, because they are divided into tens. Underneath this line are figures 1, 2, 3, 4, and 5, &c. to 1; then 2, 3, 4, 5, &c. to 10 at the end; and under this line of figures is a line of divisions called duodecimal, because it is divided into twelves or parts of twelve. Under this line of divisions is a line of figures from 2 to 20, which are for the number of shillings in one pound. This line is marked shillings. Under this line is another line of figures, from 3 to 24 marked pence, for the number of pence in two shillings, corresponding to the line above, but decreased in value in a tenfold proportion; under this line of pence is another line of farthings and pence, in a still further decreased proportion to the others. At the right hand of these last three lines of figures are marked the value of the line descending from one ground the integer to one farthing. The upper stock of the rule contains the exact counter part of the figures and

* In the plate of the Improved Sliding-Rule in No. 322, the subdivision lines denoting pence between the shillings on the duodecimal line on the *slide*, and which lines should have been laid down in a corresponding manner to the lines on the upper part or stock of the rule are omitted: but as I shall in a short time submit to the readers of the "Mechanics' Magazine" a plan for laying down the lines of a sliding-rule of the same dimensions, it will be a ready means for enabling any person to correct the error.

divisions as laid down on the slide, but the order of them is reversed. On the lower stock is a line of numbers corresponding to the line on the slide and upper stock. There are also lines of inches divided into eight, ten, and twelve parts to an inch, for any purpose they may be wanted.

In proceeding with the description of this side of the rule, it will not be necessary to notice the line of numbers, that being already done in the description of the other side. The line of divisions called duodecimal belong to either the line of numbers, 1, 2, 3, &c. to 10, or to the line of shillings 2, 3, 4, &c. to 20. The spaces between each figure on the duodecimal line are divided into parts of a shilling, from 2 to 6 are six divisions, each being valued at two-pence, from 6 to 10 at four-pence each, and from 10 to 20 at six-pence each. The long strokes will be 11, 13, 15, 17, and 19 shillings; this line must be always made use of when the subject of calculation relates to money in pounds and parts of a pound sterling; but when the subject of calculation relates to superficial or cubical measure in feet and inches, then the line of numbers must be made use of, and the divison on the duodecimal line will be inches for the parts of a foot measure; of which more will be explained in the examples of measuring surfaces. The other two lines of pence, and farthings and pence, are figures denoting their respective value. When the decimal line of numbers is used for pounds, and parts of a pound sterling, the long and short divisions must be carefully attended to in forming the estimated value in any question or answer. The space from 1 to 2 is divided into ten long strokes or divisions, and ten subdivisions, making together twenty; so that if 1 is called one pound, then each of the long divisions will be two shillings, and the subdivisions will be one shilling. From 2 to 5 is divided into ten strokes, so that if 2 is two pounds, each stroke will be two shillings. From 5 to 10 is divided into five strokes, so that if 5 is five pounds, then each stroke will be four shillings, and 6 will be six pounds, and so on to 19 for ten pounds. Again, if 1 is called ten pounds, each stroke between 1 and 2 will be one pound, and the subdivisions or short strokes ten shillings; 2 will be twenty pounds, 5 will be fifty, and 1 at the end will be one hundred; in the same manner as has been explained as to the other side of the rule.

The following rules are necessary to be observed for estimating the amount or value of any question or answer, in pounds, shillings, and pence. The figures on the three lowest lines on the slide, are expressive of their value. If any nomination is wanted between the figures, it must be carefully estimated. Suppose sixpence half-penny is required, look for 6 on the line of pence, and estimate the half towards seven-pence, and that will represent the point wanted. Suppose nineteen-pence half-penny is wanted, look for 18 and one division on the same line, and estimate half towards the next division, and that will represent the required point. Again, if two-pence half-penny is wanted, look for 2 on the line of farthings and pence, and estimate half towards 3 on the line of pence, and a supposed line drawn across that point will be the answer required, namely, over the figure of one farthing which is a tenfold decreased proportion from two-pence half-penny. Or take the example ascending, and two-pence half-penny will be a tenfold increase of one farthing. Suppose 2*s.* 6*d.* is wanted, look for 2 on the line of shillings, and three of the divisions towards 3 will be equal to two shillings and six-pence. Again, required 2*s.* 9*d.*; continue one and a half more divisions towards 3, and that point will be the answer. Again, required 13*s.* 3*d*; look for the figures 12 on the line of shillings, and one long stroke will be 13; then estimate half between that point, and the next short stroke towards 14 will be the required point. Suppose 18*s.* 4*d.* is wanted, look for 18 shillings, and the next short stroke will be six-pence, from which point the 4 for pence must be estimated. Suppose 2*l.* 4*s.* 9*d.* is wanted, look for the figure 2 on the decimal line for two pounds, and the second division will be four shillings, and nearly half another division

for nine-pence will be the proper point.

Again, 4*l.* 15*s.* is wanted, look for 4 on the decimal line, which will be four pounds, and count seven strokes for fourteen shillings, and half the space to the next stroke will give the required point.

Suppose 12*l.* 4*s.* is wanted, call 1 in the middle for 10, and two of the long strokes will represent 12 as in integral numbers, and estimate nearly half towards the short stroke for the required point.

Again, 36*l.* 8*s.* is required, call the figure 3 for thirty, and six strokes for six pounds, which will give thirty-six pounds, and nearly half towards the next division for eight shillings.

Note.—In all operations every increase or decrease is in a tenfold proportion.

Example decreasing.

Estimate 2*l.* 1*s.* 8*d.* on the decimal line, and under it on the duodecimal line, you have 4 on the line of shillings, and one division which gives four shillings and two-pence; under this point on the line of pence you have 5 for five-pence, and under this last division on the line of farthings and pence, you have one half-penny.

Example increasing.

Look for 1 on the line of farthings and pence, which is one penny, and over it on the line of pence, is 10 for ten-pence; over this on the duodecimal line is 8, and one division for eight shillings and four-pence; and over it on the decimal line is 4 for four pounds, and nearly two divisions for four pounds, three shillings, and four pence. Again, this point being increased tenfold, would represent nearly forty-two pounds, which will be more fully explained and better understood by the following examples, which I have selected for the purpose, from Walkingham's Arithmetic, the twenty-eighth edition; in making which selection, I have used such of them as refer to transactions of practical utility in real business.

(To be continued.)

VARIATION OF THE COMPASS.

Sir—In your Magazine (No. 301) an enquiry is made relative to the variation of the compass. In answer to which, the following are assigned as reasons why the method proposed by Mr. Copcake has not been adopted

When the sun is *not* very high at noon he *appears* stationary, during which period the alteration in his azimuth is rapid, the apparent motion being nearly parallel to the horizon.

When he *is* very high at noon, though his descent is more readily discovered, the change in the azimuth is exceedingly rapid: hence, suppose only a few seconds to elapse before it is ascertained that the sun is on the meridian, there could be no dependance placed on such an observed azimuth.

Besides, there is great difficulty in taking the azimuth of an object that is much elevated.

Farther, the advantage of taking a mean of several observations would by this method be lost.

To save calculation, it is usual to take the altitude when the sun's centre is about his own diameter above the horizon, to allow for refraction.

But if it be desirable to know the variation accurately, let several observations be taken in the morning and in the evening, not only when the sun is very near the horizon, but also when he is between five and ten degrees above the horizon; and, if the ship be sailing to windward, observations should be taken when on each tack; by which the error, arising from the iron in different parts of the vessel would be corrected.

The medium of these several observations—ather, of the azimuths found thereby—would be extremely near the truth.

I am, Sir,

Yours, respectfully,

J. N.

(A private teacher.)

Devizes, Oct. 1, 1829.

REPORT TO THE DIRECTORS OF THE LIVERPOOL AND MANCHESTER RAILWAY,

On the Comparative Merits of Locomotive and Fixed Engines as a Moving Power. By James Walker, Civil Engineer. Second Edition, 1829.

Mr. Walker and Mr. Rastrick were employed in January last, jointly, by the Railway Company, to report upon the matters indicated in the title. In pursuance of this object, they visited all the principal railways in the North of England, made the most minute and careful inquiries as to the vehicles and species of moving power employed on them, and then gave the result of their investigation in separate reports. Mr. Rastrick's report we have not seen, but we understand it agrees in every essential circumstance with that of Mr. Walker, which gives the following general results:—

Capital necessary on the locomotive system.....	£91,000	0	0
Ditto, on the stationary system.....	101,000	0	0
Differences in favour of the locomotive..... ...	£10,000	0	0
Annual expense and interest of capital on locomotive system	43,000	0	0
Ditto, ditto, on stationary system.....	33,000	0	0
Difference in favour of stationary system.....	£10,000	0	0
Locomotive system—rate per mile.....	·2787 of a penny		
Stationary system—do.....	·2134 do.		
Difference 1-16th of a penny, or	·0653 do.		

Or the rate by the two systems is as 7 to 9 in favour of the stationary engines.

Mr. Walker however candidly observes, that improvements are now making in the construction of locomotive engines, which may reduce the expense of employing them so as to alter the above results materially. In the stationary system, accidents, he thinks, will be less frequent; but when they occur, they will extend to the whole line. In the locomotive system, they will be confined to the single engine which goes wrong, and its train. In the stationary system, there must be a perfect sympathy and uniformity from end to end. In the locomotive system, one engine, with its train, by passing to the sidings, may stop any length of time it finds necessary, without preventing the others from pursuing their course. Messrs. Walker and Rastrick give the following joint opinion as to the two modes.—"Upon the consideration of the question in every point of view, taking the two lines of road as now forming, and having reference to economy, dispatch, safety, and convenience, our opinion is, that if it be resolved to make the Liverpool and Manchester Railway complete at once, so as to accommodate the traffic stated in your instructions, or a quantity approaching to it, the stationary reciprocating system is the best; but that if any circumstances should induce you to proceed by degrees, and to proportion the power of conveyance to the demand, then we recommend locomotive engines upon the line generally, and two fixed engines upon Rainhill and Sutton Planes, to draw up the locomotive engines, as well as the goods and carriages."

ON THE PROPERTIES OF THE HEBDOMAD, OR NUMBER SEVEN.

Sir,—The hebdomad possesses many admirable properties, and is of a venerable nature, as its name implies. Concerning these properties much has been transmitted us by the ancients, but they have been discussed by none so copiously as by Philo the Platonic Jew, who in his treatise De Mundi Opificio, has written an encomium of this number, the following translation of which I send for insertion in your valuable Magazine.

I am, &c.

Walworth. THOMAS TAYLOR.

Translation.

"I know not whether any voice can sufficiently celebrate the nature of the hebdomad, which is too excellent to be described by the power of words; yet it is not proper to be silent, though what is said about it is of the most wonderful nature; but we should endeavour, if we cannot relate all and its principal excellencies, to render manifest at least such of its properties as are accessible by our reasoning power. The hebdomad, then, is spoken of in a twofold respect; one, indeed, subsisting within the decad, which is seven times measured by the monad alone, and consists of seven monads; but the other is external to the decad, of which the principle is entirely the monad, according to double, or triple, or, in short, analogous numbers; and such are the numbers, 64 and 729: the former indeed increasing by a duplication from unity; but the other by a triplication. Each species, however, ought not to be negligently considered. The second species, indeed, has a most manifest prerogative. For the hebdomad, which is compounded from double, or triple, or analogous numbers from the monad, is both a cube and a square, comprehending both species; viz. of the incorporeal and corporeal essence; the species of the incorporeal, indeed, according to the superficies, which is formed by squares; but of the corporeal, according to the other dimension, (depth) which is formed by cubes. But the credibility of what is said is most manifest in the above-mentioned numbers. For the hebdomad 64, which is immediately increased from unity in a duple ratio, is a square produced by the multiplication of 8 by 8, and it is also a cube, the side or root of which is 4. And again, the hebdomad, which is increased in a triple ratio from the monad, viz. 729, is a square, indeed, formed by the multiplication of 27 by itself, and is also a cube, the side of which is 9.* By always making, too, a hebdomad the principle, instead of the monad, and increasing according to the same analogy, as far as to the hebdomad, you will always find that the increased number is both a square and a cube. The hebdomad therefore compounded in a duple ratio from 64, will be 4096,* which is both a square and a cube; a square having for its side 64, but a cube, the side of which is 16."

Let us now pass to the other species of the hebdomad, which is comprehended in the decad, and which exhibits an admirable nature no less than the former hebdomad. This, therefore, is composed of one, two, and four, which possess two most harmonic ratios, the duple and the quadruple; the former of which forms the symphony diapason, and the latter the symphony desdiapason. This hebdomad also comprehends other divisions, consisting after a manner of certain conjugations. For it is in the first place divided into the monad and hexad, afterwards into the decad and pentad, and lastly into the triad and tetrad. But this analogy or proportion of numbers is also most musical. For 6 has to 1 a sextuple ratio, and the sextuple ratio produces the greatest interval in tones, by which the most sharp is distant from the flattest sound, as we shall demonstrate when we make a transition from numbers to harmonies. Again, the ratio of 5 to 2 exhibits the greatest power in harmony, nearly possessing an equal power with the diapason, as is most clearly exhibited in the harmonic canon. But the ratio of 4 to 3 forms the first harmony, the sesquitertian, which is diatessaron.

"Another beauty likewise of this hebdomad presents itself to the view, and which is to be considered as most sacred. For since it consists of the triad and the tetrad, it exhibits that which is undiverging and naturally in a direct line in things. And it must be shown after what manner this is effected. The rectangular triangle, which is the principle of qualities,

* Thus, $1\times2\times2\times2\times2\times2\times2=64$; and $1\times3\times3\times3\times3\times3\times3=729$.

* For $64\times2\times2\times2\times2\times2\times2=4096$. And thus also the hebdomad compounded in a triple ratio from 64 will be 46656, which is both a square and a cube; for the square root of it is 216, and the cube root is 36.

consists of the numbers 3, 4 and 5.* But 3 and 4, which are the essence of this hebdomad, form the right angle. For the obtuse and the acute exhibit the anomalous, the irregular, and the unequal; since they admit of the more and the less. But the right angle does not admit of comparison; nor is one right angle more right than another, but it remains in the similar, and never changes its proper nature. If, however, the right angled triangle is the principle of figures and qualities, and 3 and 4, the essence of the hebdomad, necessarily impart the right angle; this hebdomad may justly be considered as the fountain of every figure, and of every quality. To what has been said, it may be properly added, that 3 is the number of a plane figure, since a point is arranged according to the monad, but a line according to the decad, and a superficies according to the triad. But 4 is the number of a solid, by the addition of unity giving depth to superficies. Hence it is manifest, that the essence of the hebdomad is the principle of geometry and stenometry, and, in short, it is the principle of incorporeal and corporeal natures.

"There is also naturally so much of what is adapted to sacred concerns in the hebdomad, that it has a pre-eminence with reference to all the numbers that are within the decad. For of these some beget, not being themselves begotten; but others are begotten, but do not beget; and others both beget and are begotten. The hebdomad, however, is alone beheld in no part of these, which may be confirmed by demonstration as follows. Unity, therefore, generates all the numbers that are posterior to it, but is by no means generated by any number. Eight is indeed generated by twice four, but generates no number within the decad. Again, 4 ranks among those natures that both beget and are begotten: for it generates 8 by being multiplied by 2, and is generated by twice two. But 7 alone, as I have said, is neither naturally adapted to generate, nor to be generated. Hence other philosophers indeed assimilate this number to Victory, who is motherless and a virgin, and who is said to have sprung to light from the head of Jupiter. But the Pythagoreans assimilate it to the leader and ruler of all things. For that which neither generates, nor is generated, remains immoveable; for generation subsists in motion, since that also which is generated is not without motion. For that which generates is in motion, in order that it may generate, and also that which is generated, in order that it may be generated. But the most ancient principle and leader of things, of whom the hebdomad may appropriately be said to be the image alone, neither moves nor is moved. Philolaus bears testimony to the truth of what I say in the following words: 'God (says he) is the leader and ruler of all things, being always one, stable, immoveable, himself similar to himself, and different from other things.' In intelligibles, therefore, the hebdomad exhibits the immoveable and the impassive; but in sensible it evinces a mighty and most connective power, by which, and by the periods of the moon, all terrestrial things are naturally adopted to be benefited. The manner, however, in which this is effected must be considered.

"The number 7 being added to unity, and the numbers that follow it generates 28, a perfect number, and

* Viz. The first rectangular triangle, whose sides are commensurable, consist of the numbers 3, 4, and 5. For the area of such a triangle is 6, being equal to half the product of the two sides 3 and 4, *i. e.* $\frac{3\times4.}{2}$ But the sides of any rectangular triangle, whose area is less than 6. will be incommensurable. Thus, if 5 is the area of a rectangular triangle, it will be equal to $\frac{2\times5}{2}$ or to $\frac{1\times10.}{2}$ Hence the two least sides will be either 2 and 5, or 1 and 10, and the hypothenuse will either be $\sqrt{29}$, or $\sqrt{101}$, each of which is incommensurable. This also will be the case if the area is 4, or 3, or 2. And as the commensurable is naturally prior to the incommensurable, the rectangular triangle, whose sides are 3, 4, and 5, will be the principle of the rest. Hence, too, it is evident why 3 and 4 form the right angle.

a parts.* But the number
ated is apocatastatic of the
. has the power of restoring
stine state, at the time in
moon begins to receive a
crease of its figure, and to
decreasing, it returns. It
indeed, from the first lunar
nination till it is bisected,
ven days: afterwards, in
number of days it becomes
. And again, running back
from the goal through the
, from being full-orbed, it
gain bisected in seven days;
this, in the same number of
cquires its first form, and
completion to the number

hebdomad also is called by
employ names properly,
, or *the perfector*, because
acquire perfection through
er. The truth of this, how-
he inferred from every or-
y employing three intervals
sions, *i. e.* length, breadth,
h, and four boundaries, a
ne, a superficies, and a solid,
composition of which the
l is formed. It would, how-
impossible for bodies to be
by the hebdomad, accord-
composition of three dimen-
four boundaries, unless it
that the ideas of the first
viz. of one, two, three, and
which the decad is founded,
nded the nature of the heb-
For these numbers have
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e third, and the fourth, but
rvals, the first interval being
2, the second from 2 to 3,
third from 3 to 4. Inde-
lso of these things, the ages
ncy to old age most clearly
ne perfective power of the
l, since they are measured
the first seven years, there-
teeth shoot forth. In the
the time of puberty. In the
ere is an increase of the
nd in the fourth, there is an
of strength. The season of
is in the fifth. But in the
he acme of intelligence. In
the seventh, there is an amelioration
and an increase both of intellect and
reason. But in the eighth, perfection
in each. In the ninth there is equity
and mildness, the passions for the
most part becoming gentle. And in
the tenth age, is the desirable end of
life, the organic parts being still
entire; for extreme old age is wont to
supplant and afflict. Solon also the
Athenian legislator, enumerates human life by the above-mentioned hebdomads. But Hippocrates, the physician, says, there are seven ages; viz.
of the infant, the child, the lad, the
young man, the man, the elderly man,
and the old man, and these are measured by hebdomads, but do not extend beyond seven. His words are
as follow: 'In the nature of man
there are seven seasons, which they
call ages, the infant, the child, the
lad, &c. And infancy, indeed, continues to the shedding of the teeth,
but the child to the generation of the
seed, which extends to twice seven
years. The lad continues till the
beard becomes rough with hairs; but
the young man, as far as to the increase of the whole body, which extends to four times seven years. The
man continues as far as to fifty years'
wanting one, *i. e.* to seven times seven
years; but the elderly man, as far as
to fifty-six years, *i. e.* to seven times
eight years. And all the years that
follow this pertain to the old man."

(To be continued.)

1+2+3+4+5+6+7=28.

MAXIMA AND MINIMA.

Sir,—I am exceedingly obliged to your correspondent, G. S., for his able communication in No. 322; but I regret to say, that he has quite mistaken the drift of my enquiry.

I was perfectly aware that some quantities admit of no maximum, and others of no minimum; and I by no means intended to dispute the correctness of making the fluxion of a maximum or minimum $=0$, but the sole point upon which I asked for elucidation was this—whether in an impossible question, such as the one I proposed, the impossibility could be deduced from the *fluxionary expression* of it? And I illustrated my

meaning by referring to the case of an indeterminate problem in algebra, whose impossibility becomes apparent, by applying the common rules for solving an equation. Now, as it is plain that, whether a question be possible or not, it can always be cast into the form of an algebraic equation, does not the same hold good with regard to fluxions? And as its impossibility can be clearly deduced from the simple form of its algebraical expression, can it likewise be deduced from its fluxionary one?

I will explain myself still more familiarly, since I am really anxious for an answer to my query. Suppose I were to put the following question to an algebraist: Can I pay £10 in half guineas?—*A.* It is impossible; for 20 half guineas are too many, and 19 too few.—Very true, I reply; but this is not the answer I desire: turn the question into an algebraic equation, and show its impossibility from *that*. This, of course, can be easily done; and this is what I wish to know with respect to an impossible question translated into a fluxionary equation.

I enquired, in conclusion, how the question was to be solved when restricted to whole numbers, in which case it becomes possible: G. S. has omitted to answer this. I have found a method which gives a correct solution; but I should like to see whether those who understand the subject far better than I do would adopt the same.

I remain, sir, your much obliged,

D. C.

MINOR CORRESPONDENCE.

Sir,—I have in my possession a plan that will completely consume the smoke arising from a steam-engine fire. It is particularly well adapted for locomotive steam-carriages, as it would occupy little room, would not require any extra flues, and only add a few pounds to the weight of the machine. The writer of this is willing to communicate it to any gentleman of respectability; and if it does not answer in the manner stated above, no remuneration will be expected. The address of the writer may be obtained by applying at the office of the "Mechanics' Magazine."

Yours, &c.

Z.

Antidote in case of Swallowing or being Stung by Wasps.—Sir, Having lately heard of the loss of life, in two instances, in consequence of swallowing a wasp, the following remedy, if made public through your much read Magazine, may in similar cases prove effectual.

I am, Sir, yours,

A. E. B.

Swallowing a Wasp.—As soon as possible, dissolve salt in the mouth, swallow the saliva; repeat it while there is a tendency to inflammation or swelling.

For the Sting of a Wasp, or Bee.—Moisten salt with a little water, and instantly rub the part affected with it.

Rifle Match.—Mr. Editor, Should any of your numerous readers have been as much interested as I was by the perusal of the Essay on Rifles and Rifle-shooting, contained in one of your recent Numbers, they will be glad to be informed, that they will shortly have a fine opportunity of seeing the practical use of that deadly weapon exemplified by two of our best riflemen, who have made a match to fire, at Chalk Farm, at the distance of 100 and 200 yards. Any person inquiring at the bar of the Chalk Farm tavern within three weeks hence, will hear of the day fixed on.

Your obedient servant,

R.

INTERIM NOTICES.

We have received a printed statement, signed "William Culbard, 138, St. John-street, West Smithfield," in which the writer certifies that he was favoured a few days ago with a ride in a new steam-carriage, weighing less than one ton, belonging to Sir James Anderson, Bart. and W. H. James, Esq., from Vauxhall-bridge to the Swan at Clapham, a distance of 2½ miles, which it accomplished in about 10 minutes, being at the rate of 15 miles an hour. Mr. Culbard does not hesitate to add, "that had this carriage been on the Manchester and Liverpool Railroad (where the friction is ten times less than on a common road), it would have gone three or four times *faster* than the *fastest* of the vehicles tried thereon!!" We shall be glad to receive some further information respecting this prodigy of invention.

The manner in which our columns are occupied, will explain to Mr. Baddeley—Henry D—Mr. Walker—Mr. Harrison—Mr. Davy—S. P. W.—the author of "Notes on Town," and several other esteemed Correspondents, the cause of the delay in the insertion of their communications.

We do not believe one word of Mega's statement; we know some parts of it to be wilfully false.

The paper of "Medicus" would better suit some of the medical journals.

Communications received from Mr. Hopwood—R. R.—Another Eye-witness—Mr. Reeve—J. E. Y. E.—Ferro—R. W. F.—A Turner—K. C.

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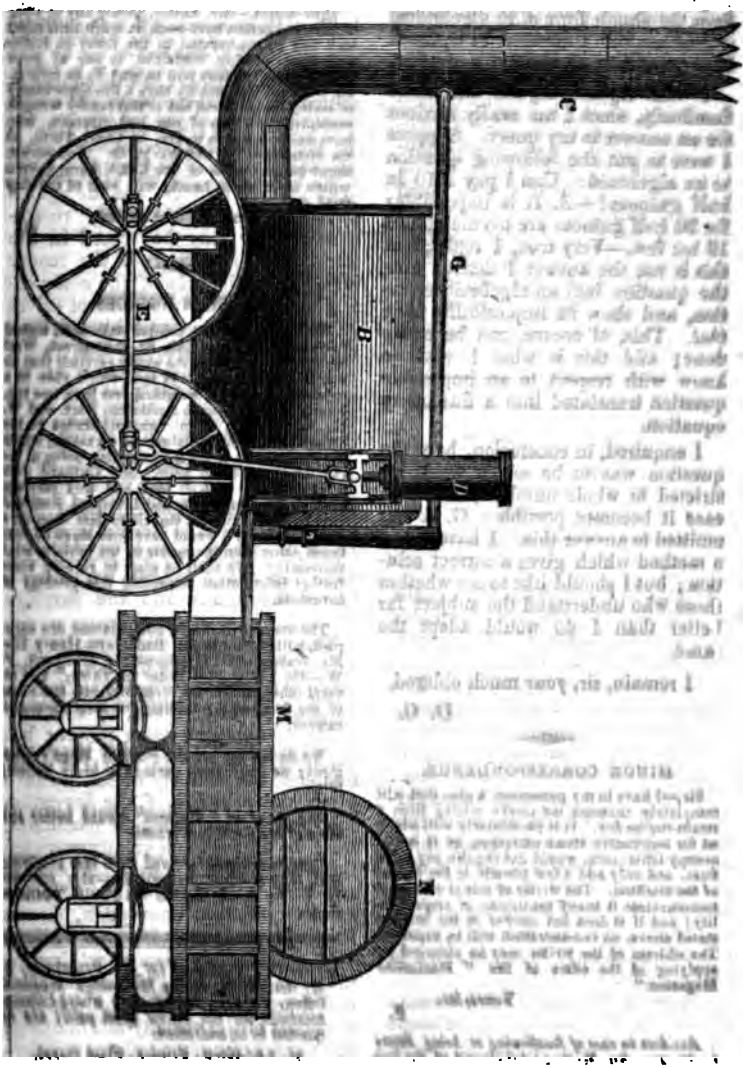
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 328.] SATURDAY, OCTOBER 31, 1829. [Price 3d.

THE "SANS PAREIL," LOCOMOTIVE STEAM ENGINE OF MR. ACKWORTH, OF DARLINGTON.

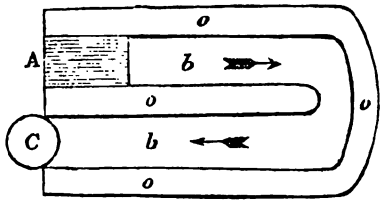


DESCRIPTION OF THE ENGINES WHICH COMPETED FOR THE PRIZE OF £500 ON THE LIVERPOOL AND MANCHESTER RAILWAY.

(Continued from last Number, p. 158.)

3. The Sans Pareil—*Mr. Ackworth, of Darlington.*

The engraving on the preceding page presents an external view of this engine, and its tender, on the same scale as "The Rocket," namely, a quarter of an inch to a foot. It exhibits in its general appearance—particularly in its large dimensions—a near resemblance to Mr. Stephenson's engine; but is much more compactly arranged, and on account of this compactness, travels with much greater steadiness. The furnace and boiler are not placed head-and-tail-wise, as in "The Rocket," but form together the main body (B) of the engine, being constructed in the manner represented in the following diagram:—



A is the furnace, *bb* the flue or tube through which the heated air passes in the direction marked by the arrows, to the chimney C. The boiler (*oooo*) surrounds the furnace and flue. The working-cylinder D, and connecting-rod E, &c., are similar to those of "The Rocket," with the exception of being vertical instead of horizontal. The waste steam passes into an external pipe G, which has an ascending direction given to it towards the chimney C; so that whatever portion of it is there condensed may fall back through the vertical branch-pipe at its lower extremity into the feed-pumps (one of which only is represented in the drawing).

The mode of generating the steam adopted in this engine is the same which Trevethick introduced as far back as 1804, and possesses all the *merit which has* been generally conceded to that plan, without exhibiting any effort to obviate the objections that have been as generally made to it. The furnace and boiler are of simple construction, and of unquestionable efficiency; but their great size, and the large supply of fuel and water they require, render them but ill-adapted to the purposes of a locomotive engine.

4. The Cycloped—*Mr. Brandreth, of Liverpool.*

The motive power in this engine is gained in the same way as in the tread-mills of prison celebrity, and the dog-mills which we have sometimes heard of—only that horses, instead of men or dogs, are the agents employed. A still nearer resemblance to it may be traced in the common squirrel-cage, if the reader will, but for the sake of the comparison, suppose that the squirrel drives its circular cage round by treading on the outside instead of the inside. A common waggon-frame mounted on wheels is divided longitudinally into two compartments or stalls, and the bottom of each of these stalls is occupied by an endless chain of cross-bars, which work into and revolve round the axles of the carriage. The horses are placed in the stalls, and by treading on the endless chains produce the rotary motion requisite to propel themselves and the carriage forward.

The experiments made on the railway with this engine did not, we believe, establish any gain, either in point of power or speed, by this new mode of applying horse power; but the apparatus was of rude construction, and can scarcely be said to have given the principle of the invention fair play. The stalls, in particular, were too narrow, and greatly cramped the action of the horses. We have no doubt that in a well-constructed carriage of this description, horses might be made to work *on a railway* with considerably more effect than by drawing, or, at least, with equal effect and more ease. One of the principal elements of the velocity attainable on railways is the momentum which a body in motion acquires on a level or down an inclined plane; and this

must often reach a point, at which any power of draught that can be applied will be not only of no use, but an actual obstruction to the velocity of the body. Suppose this momentum should amount to a force equal to a velocity of 13 miles, *that* is a rate of velocity at which the utmost a horse can do is to move its own weight; so that were he even able to continue galloping in advance of it, he would gallop to no purpose. But suppose farther that the momentum or velocity of gravitation should exceed the speed of the horse—which as there are few horses that can travel 13 miles an hour, is a very probable case—either the horse must be run down, or the carriage compelled to stop. Now, by transferring the horse to the inside of the carriage, he will be not only removed out of the way of this momentum, but enabled to participate in the benefit of it; he will be spared all the toil of running a head of the carriage to no purpose, and required to exert no more power than is just necessary to overcome the friction of the road, that is, to set the carriage a-going.

Any power, however, which such a carriage as "The Cycloped" might possess must always be much inferior to that obtained through the agency of steam, both in cheapness and efficiency.

5. THE PERSEVERANCE—*Mr. Burstall, Edinburgh.*

The name of this engine may be considered as commemorative of the spirit with which its ingenious inventor has persevered for several years, and under many discouraging circumstances, in his endeavours to apply steam power to the propulsion of carriages on common roads. "The Perseverance" does not differ in many material respects from the original steam-carriage of Mr. Burstall, which we described at length in our fourth vol. p. 433. The chief difference is, that the boiler and furnace, instead of occupying the same carriage with the rest of the machinery, are placed on a separate carriage, attached to the hinder part of the other, and the object proposed to be *gained* by this alteration is, *that they may* be more out of the way of the passengers in the event of any explosion taking place.

Among the most valuable of the subordinate improvements may be ranked a mode of steering the front wheels, by means of a spur and an endless chain, instead of a wheel and a pinion, as in the original machine, and a provision for obtaining at will an increase of power in ascending hills.

Comparative Statement of the Performances of the Engines which competed for the Premium offered by the Directors of the Liverpool and Manchester Railway.

In drawing up the present comparative statement, we have left altogether out of consideration the particular competition which called forth the performances here contrasted, and have looked simply to the performances themselves without reference to any conditions or stipulations whatever. It by no means follows, that because the judges in this competition thought fit to require that each engine should run a distance of seventy miles, it is only from the performance of such a distance continuously we can form a right judgment of the capabilities of an engine, or that, because "The Rocket" was the only engine which accomplished that distance, it is superior to every other. All that is requisite is, that the distance should be such as to exclude the possibility of our mistaking a momentary for a permanent display of power; and a distance of twenty or thirty miles is as good for this purpose as one of sixty or seventy. The case will, perhaps, be set in a clearer light, if we substitute *time* for *distance*. No one would think of calling an hour's running at a time a mere momentary display; nor can any reason be imagined why an engine that can go fifteen, twenty, or thirty miles in one hour, should not go at the same rate for any number of hours. A steam-engine is not like a horse, which becomes gradually exhausted by exertion; it is as strong and fresh at the end as at the beginning of any journey, however long that journey may be. It has its source of power in the steam generated by the

boiler, and the same quantity of steam which a boiler generates at one time it must be capable of generating at any other time (the supply of water and fuel remaining always the same). The durability of the materials of which the boiler consists may be affected by the continuity of the process; but that is an evil which would scarcely in any case be felt till after the lapse of a considerable period. It is not, at least, such a drawback as would be taken into account in any experimental trial of the description contemplated by the late competition. Now, though "The Novelty," "The Rocket," and "The Sans Pareil" did not all run 70 miles each, as required by the "ordeal" of Messrs. Rastrick and Wood, they all ran uninterruptedly for more than an hour at once, and to contrast what they did in this equal and adequate space of time, is manifestly a much surer and fairer method of determining their comparative services, than to rank them according to the total distances they ran in different times.

Neither "The Cycloped" and "Perseverance" did perform for an hour continuously, and they are not therefore included in our comparison.

I. The first point to which we have to attend is the respective weight of the engines, since according to their weight must be the degree of friction which they have to overcome. For the reasons we gave in our 323rd Number (pp. 137—141) there must be included in this weight the whole working power of each engine, that is, the whole of the machinery and the whole of the materials necessary for putting and keeping it in motion; and, for the sake of greater clearness, we shall reduce this weight into pounds. Each engine is supposed to be fully equipped for a journey of 35 miles continuance.

	Tons.	Cts.	lbs.	lbs.
"The Novelty" weighed, according to the canal carrier's receipt	2	15	0	
Add for water in the boiler	0	4	2	
Water in the tank	0	11	12	
Coke baskets and coke	0	0	76	
The three last items estimated by Mr. Vignoles (p. 138.)				
	3	10	90	= 7,930
"The Rocket," according to the official list of the carriages entered for the competition, weighed	4	3	0	
The additional tender, with its contents, was stated to weigh	1	13	0	
	5	16	0	= 12,992
"The Sans Pareil" weighed, according to the same official list	4	8	0	
Add for tender and its contents	1	13	0	
	6	1	0	= 13,552

From this comparison it appears, that the working power of "The Novelty" weighs little more than one-half that of either of the other engines. It must of course have to that extent less friction to overcome, and do less injury to the rails. It may be supposed that as it weighs less, it will exert proportionably less power: but *this is not the case*; the area of the *cylinder being* nearly, and the pressure on each piston precisely the same, in all the three engines.

II. We have next to consider the *quantity of fuel* consumed by each engine.

The owners of "The Novelty" professed to be able to go one trip of 35 miles with 4 bushels of coke; and what they did perform leaves no doubt on our minds that this is a fair

ıte of the quantity that would be
ed for such a distance.
ı fuel consumed by "The
t" in performing its two trips of
les each, was stated to be about
ı ton.
the quantity which "The Sans
" consumed in going its 25
we have no exact account, but
ıve been informed that it was
r as much as "The Rocket"
ed for performing double the
ce. The different construction

of the boilers of the two engines furnishes a sufficient reason for believing that "The Sans Pareil" must consume a great deal more fuel than "The Rocket;" and we shall not probably err much if we assume that the difference amounts to one-fourth more.

The quantity and cost of the fuel expended by each engine per mile will according to these data stand as follows:—

	PER MILE. Quantity. lbs.	oz.	dr.	Cost about.
ı Sans Pareil (12 cwt. 2 qrs. ÷ 75) . .	18	10	10	2 pence.
ı Rocket (10 cwt. ÷ 75)	14	14	14	3 halfpence.
ı Novelty (4 bushels, or 168lbs. ÷ 35) .	4	12	12	1 farthing.

ı saving of expense is not the
ıdvantage gained by reducing
ıpenditure of fuel; there may
ıations indeed where fuel is so
as to make any saving in this
t of no moment. A matter of
eater importance is the increased
y which is thus given to the
yment of steam power for the
plishment of long distances—
particularly. An engine which,
The Novelty," is worked with
ırds less fuel than any other
, will of course go three times
stance with the same quantity,
ve only to stop once to take in
supply, while the others have
ı three times.
eduction so great as has been
d in the case of "The No-
was never before accomplish-
ır ever we believe supposed to
thin the limits of attainment.
urney was thought to have done
rs, when it was announced that
ly consumed half a bushel of
er mile, at an expense of two-
; but here we have a mile per-
l with less than the fourth of
ı bushel, at an expense of only
rthing!

We now proceed to compare
te of speed accomplished by the
nt engines.
he Novelty" went on the second
f the competition, with three
ns weight attached to it, 20¾
in one hour. The total weight
, including the carriage, was

about 15 tons. In calculating the weight in this instance, no deduction was made on account of the engine's carrying its own water and fuel, but when prepared for its intended trials on the subsequent days of the competition due allowance was made for this circumstance. The load then assigned to it by the judges was 6 tons 2 cwt.* When it accomplished the trips recorded by Mr. Vignoles, (p. 138) the total weight moved, including that of a number of persons on the engine and waggons, was only 10 tons 6 cwt. 1 qr.; and the speed which it then realized was nearly equal to 22 miles an hour. It will be observed, that though some increase of velocity was thus acquired, it was by no means proportional to the reduction of the weight; a circumstance which is doubtless to be ascribed to the very imperfect working order in which the engine was at the time of this second trial. When the weight drawn was reduced to merely that of a waggon containing 45 persons—equal to about 3½ tons—and the total weight moved to about 9 tons, the velocity was increased to 30 and 32 miles per hour; a rate which though unprecedentedly great, is still less than what the previous

* In our account of the seventh day's competition we stated, that the weight assigned was 5 tons 16 cwt.; the difference arises from our omitting to include the weight of the water in the boiler.

performances of this engine, with double that weight, might have warranted us to expect from it.

The total weight moved by "The Rocket" when it went the 70 miles continuously was 17 tons; and the greatest number of miles which it traversed in any one hour was 12½. Stripped of all weight, and carrying just as much *materiel* as would suffice for a couple of trips of a mile and a half each, it went at the rate of 30 miles an hour. Drawing a carriage loaded with passengers, it went at a velocity which sometimes reached 24 miles an hour.

The weight drawn by "The Sans Pareil," if calculated in the same way as that assigned to "The Rocket," must have been 13 tons 6 cwt. (and not 1800 tons, as stated in our account of the sixth day's proceedings)—the total weighed moved 17 tons 14 cwt. The greatest speed which it accomplished in one hour was 12½ miles.

The comparative speed of the three engines, as verified by the recent experiments, stands therefore as follows:—

MILES PER HOUR.

	With a Load equivalent to three times the weight of the engine.	With a Carriage and Passengers.
The Sans Pareil . .	12½	—
The Rocket	12½	24
The Novelty . . .	20¾	32

The superiority of "The Novelty" is least apparent in the instance of its drawing the least weight; but that as we have before said, must have been owing to its being in a less efficient state on that occasion. Since "The Rocket" doubled its rate of speed when it had only a carriage and passengers to draw, we can see no reason why "The Novelty" should not have done the same, had its machinery continued in an unimpaired state.

Award of the Premium.

Extract of a Letter from a Correspondent.

"Liverpool, 26th Oct. 1829.

"The prize has been at length awarded, and as you rightly conjectured in your last, to Mr. Stephenson. The directors had no alternative, since "The Rocket" was the only engine which fulfilled the conditions of the competition. There are people here, however, who think that the interests of the public would have been quite as well served, had the directors adjudged the premium on a more general view of the matter, and conferred it on that engine which is, upon the whole, "the most improved." I have seen at the Railway-office the Report of *the Judges; but* cannot say that I have been at all gratified by the perusal. It is confined to a simple report of the performances of the different engines, drawn up with but little discrimination, and in some instances (as I imagine) rather ignorantly. It might have been expected of two gentlemen, who were called in to aid a body of directors with their scientific knowledge on the occasion, that they would have made it their business to point out the improvements which the competition has been the means of producing in locomotive machinery, by whom they have been effected, and to what results they lead. But there is nothing of the kind. The directors are left to cull conclusions for themselves out of the facts presented to them; and for aught that appears in the face of the report, it might be inferred that all the *novelty* is on the side of the *Rocket*, and that the *Rocket* is the only real *Sans Pareil*. I need not, however, enlarge on the merits of this document; it will, of course, be soon given to the public, and speak for itself. The directors have offered to purchase both the unsuccessful engines—unsuccessful, at least, as regards the prize; but the offer does not seem to have been viewed in the same light by their respective owners. Ackworth, who had embarked all his

means in the building of "The Sans Pareil," has gladly accepted the offer; Messrs. Braithwaite and Ericsson have declined it, under an impression that it might seem their engine was bought less for its merit than on account of its misfortunes. They say they want nothing in the way of favour; and that if they can prove, as they trust to do, that their engine is better adapted to railway purposes than any other which has yet appeared, it will not be an order for one, or a dozen, or yet fifty engines, that will satisfy the wants of our railway. "The Novelty" is still here, undergoing a general repair, and is expected to exhibit again on the railway in the course of next week, when it will be brought to a final test, whether it can maintain, for a length of time, the extraordinary speed which its partial performances during the competition displayed."

(*From the Liverpool Times of Oct. 27.*)

"THE RAILWAY CONTEST.—On Tuesday last, the judges appointed to report on the performances of the locomotive carriages at Rainhill, gave in their report to the directors, and in consequence of the opinion expressed by them, the prize of £500 was adjudged by the directors to Mr. Robert Stephenson, of Newcastle. It has not yet been decided whether the report of the judges shall be published or not: we understand, however, that it expresses no opinion as to the principle of Messrs. Braithwaite and Ericsson's carriage, but merely gives a statement of the respective performances of the different carriages.—Messrs. Braithwaite and Ericsson, the proprietors of "The Novelty," and Mr. Robert Stephenson, the proprietor of "The Rocket," are both engaged in improving and perfecting their carriages. The former is now repairing at Messrs. Fawcett's yard; and it is said that it will be tried again on the railway when finished. A considerable alteration has also been made in Mr. Robert Stephenson's engine, which has greatly increased its powers. It was tried again on Saturday, when it drew the enormous weight of 20 tons, at the rate of from *18 to 20 miles* per hour."

On the comparative Advantages of Railways, Canals, and Common Roads.

WE intended to go at some length in this Number into the general considerations which the recent experiments at Liverpool suggest, with respect to the advantages of railway conveyance; but we have not leisure this week to do sufficient justice to the task. We present our readers in the meanwhile with two extremely interesting extracts on the subject; one from the *Scotsman*, which had the honour, four years ago, of first bringing forcibly under public notice the advantages derivable from locomotive carriages on railways; and the other from a letter which has just been published, addressed by John Herapath, Esquire, to the Duke of Wellington. Mr. Herapath's letter has not, it is true, for its object to demonstrate the superiority of railways, but only to show forth "the utility, advantages, and national importance" of his friend Mr. Gurney's steam-carriage. All that he says, however, with respect to the great national benefit that will result from the substitution of steam for horse-power, on common roads, is so much more applicable to the employment of steam-carriages on railways, that we have not hesitated to appropriate it to the purpose of enforcing the superiority of the latter, over every other known mode of conveyance. Mr. Herapath overrates, we think, the capabilities of Mr. Gurney's engine—and this we shall take an early opportunity of showing—but he certainly does not overrate the benefits which the introduction of steam-carriages, whether on common roads or on railways, will confer on the country. They are, in truth, incalculable. The reader will perceive in the prospects which Mr. Herapath has very ably unfolded, a remedy for national distress, worth all the nostrums of all the State quacks, by whom we have the misfortune to be beset. Should any one indulge in a smile of incredulity at the anticipation of the *Scotsman*, that "the experiments at Liverpool have established principles which will give a greater impulse to civilization than

it has ever received from any single cause since the press first opened the gates of knowledge to the human species"—he has but to read on, and he will find that anticipation reduced by Mr. Herapath—one of the ablest of our mathematicians—to as great a matter of certainty as any demonstration in Euclid.

(*From the Scotsman.*)

"The experiments at Liverpool have established principles which will give a greater impulse to civilization than it has ever received from any single cause since the press first opened the gates of knowledge to the human species at large. They may be said to have furnished man with *wings*, to have supplied him with faculties of locomotion, of which the most sanguine could not have dreamed a few years ago. Even steam navigation gives but a faint idea of the wonderous powers which this new agent has put into our hands. It is no exaggeration to say, that the introduction of steam-carriages on railways places us on the verge of a new era—of a social revolution of which imagination cannot picture the ultimate effects.

"Let us now take the speed and the cheapness together, and see what changes this new mode of conveyance is likely to produce when railways are made along all our great thoroughfares. Let us suppose the speed to be 20 miles an hour, and the expense 1*s.* for 15 miles of road; and the fares by ordinary stage-coaches about 4*d.* per mile.

"The journey from London to York by the mail costs at present about 3*l.* and occupies 23 hours. By the steam-coach it will be accomplished in 10 hours, at an expense of 14*s.*! The saving of money and time will be as great in the case of Liverpool and Manchester, which are at nearly the same distance from the metropolis. A Leeds or Manchester manufacturer may take an early breakfast in his own house at seven, dine in London at five, transact business that night or next morning, and reach his home on the following evening, while a two-pound note will cover his whole expenses!

"The journey from Manchester to Liverpool, or from Liverpool to Manchester (31 miles), will be performed at an expense of 2*s.* in one hour and a half, or, as some already anticipate, in one hour. Now, an active pedestrian in the metropolis will spend two hours in going from Grosvenor-square to Wapping; *or, with the luxury of a hackney-coach, he may go in one hour, at an expense of 7s.* Thus, by the admirable invention of steam-carriages, Liverpool and Manchester will be brought nearer to one another in a moral, social, and commercial sense, than the extremities of London now are. If this be not absolutely annihilating time and space, it is abridging both in a wonderful degree.

"Suppose that an Edinburgh man has a friend to visit or business to transact in London. His journey up costs him two days' travelling, with a sacrifice of two nights' rest, and a sum of 7*l.*; and his journey down the same. By the steam-coach and railway he will be able to reach London in 20 hours, without losing one night's sleep, at an expense of 26*s.* or 36*s.* including his food; and his journey home will be performed in the same time and at the same expense. If we compare the two cases, the time will be as 2½ to 1, the expense as 4 to 1, and comfort and convenience as 6 to 1, in favour of the steam conveyance. The inducements to travel would be in something like a compound ratio of all these, or, to speak moderately, as 20 or 30 to 1.

"An Edinburgh dealer might send off a letter at eight at night on Monday, which would be delivered to the manufacturer in Leeds or Manchester at eight on Tuesday morning. The latter might dispatch the goods ordered in the course of the same day, and they would reach the dealer when his shop opened on Wednesday morning. Thus only one entire day would elapse betwixt writing the order and receiving the articles. The manufacturer's sale-room in Manchester would, in this case, be almost as much at the shopkeeper's command, as his own warehouse in a neighbouring street.

"An Edinburgh merchant could leave his house at seven, breakfast in Glasgow at nine (assuming that a railway is made), transact business there till two, and be home to his own dinner at four, at an expence of 7*s.* 6*d.*, namely, 6*s.* for coach-hire, and 1*s.* 6*d.* for breakfast. At present the journey, including subsistence and a night's lodging, would cost him seven times as much.

"Within a few years after steam navigation was introduced on the Clyde, the intercourse between Glasgow and Greenock, according to Mr. Cleland, was increased tenfold. The expence in this case was reduced about two-thirds, but the time was not materially shortened. What a vast addition then would be made to the present amount of internal inter-

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en the mode of conveyance is as
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nsive business, time is of still
lue than money. If the journey
dinburgh to Manchester could be
ned in ten hours, at an expence
, or 15s., every merchant knows
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places would increase, not ten,
y-fold!—Journeys for pleasure
multiply in as great a proportion
e for business; and we are satis-
at when we enjoy the advantages
ays and locomotive engines on
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ave at present.

han the carriage of goods, which
about 9d. or 10d. a ton per mile,
, is reduced to 2d.; and when, in
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, the heaviest commodities, such
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In point of fact, when the time
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is exactly the same as if Edinburgh
rought as near to London as Lei-
er Birmingham; and, to pursue the
rison, when the journey was one
day, the effect was the same as if Edinburgh had stood in Iceland. Besides, we must always remember that the intercourse grows in a much greater ratio than the distance is shortened. Volumes might be written without exhausting the materials for speculation arising out of such a change. To use our own words, when writing upon this subject in 1824, "With so great a facility and celerity of communication, the provincial towns of an empire would become so many suburbs of the metropolis—or rather the effect would be similar to that of collecting the whole inhabitants into one city. Commodities, inventions, discoveries, opinions would circulate with a rapidity hitherto unknown, and, above all, the intercourse of man with man, province with province, and nation with nation, would be prodigiously increased."

From Mr. Herapath's Letter to the Duke of Wellington.

"But cheapness and rapidity are by no means the most important advantages to be expected from the introduction of steamers. There is another of much higher moment. Adam Smith, I believe it is, informs us that one horse consumes for food as much land as would maintain eight persons. Were the part of this land required for hay thrown on the spade or the plough, it would not merely give more employment to the poor, but every steam-coach constanly in work would save that from horses, which would maintain one thousand four hundred and forty more of the human species. Ten thousand such carriages would, therefore, save stage-coach proprietors, and consequently the travelling and mercantile part of our community, from 91,759,479*l.* to 100,600,000*l.* per annum; that is, about double our whole national revenue: and would convert, for the purposes of human support, land sufficient to maintain fourteen millions four hundred thousand of persons; that is, more than the whole population of England, Scotland, and Wales. Now, I am informed, there are some millions of horses employed in Great Britain, in staging and posting, of which one million eight hundred thousand, according to Adam Smith, consume as much land as would maintain our whole population. But if steaming will dispense with the services of one horse thus employed, there can be no reason why it should not with the services of them all. And were this the case, our country might be able to support, with only the land at present in occupation, double or treble, or perhaps quadruple, its present

inhabitants! To these facts, the obvious consequences of experience, not the figments of imagination, I beg to invite your Grace's most serious attention.

"Let us now turn a thought on the consequences we may expect from the general introduction of this excellent invention. Cheapness and rapidity of conveyance are grand desiderata with men of business. The former is synonymous with profit; the latter gives them a kind of omnipresence in the kingdom. Our traders and manufacturers may now send their goods from one extremity of the country to the other, with as little expense of money and nearly of time, as a porter would require to convey them from St. Paul's to St. Giles's. With scarcely any addition of rent, the tradesman thus adds the whole kingdom to his shop, and by the rapidity of his motions keeps all under his immediate inspection. But it will not be beneficial to the manufacturer or tradesman alone; the consumer will come in for his share. A reduction of expenses will naturally lessen the price. This will consequently increase the demand; for it is an every day fact, that consumption and price are like the opposite ends of a lever, as this sinks that rises. But if trade increase, our revenue must feel its effects, which will again return on us by a reduction of our burdens. Thus will all orders of the state be doubly and trebly benefited—the merchant and manufacturer by an augmentation of trade; the poor by an increase of employment; the Government by an additional revenue; and the whole public by a diminished taxation. Nor can I see any one of the great orders that will not be advantageously affected. The cultivator of land will receive his quota from an increase of population, and the greater ability with which a new stimulus to trade will furnish the poor to purchase the necessaries of life. Even the post-master and stage-coach proprietor, who look with a prejudiced eye on the invention, will find themselves happily placed in the account. To say nothing of what they will save from avoiding the accidents, casualties, and destruction of horses (serious items in their profits), let them but look at the hundred and thousand fold increase of travelling which will follow an increase of means in the people, and so considerable a reduction of expenses. For every person who can afford a guinea to travel, we may fairly affirm there are a hundred who can afford a half, and a thousand *who can afford a* third of that sum. It *may also be added*, that of those who at this time are compelled by economy to go by the stage, numbers, on so material a reduction, will take a steam-chaise to themselves. In fine, instead of that murmuring idleness which is but too commonly seen in our towns and villages, we may reasonably hope before long for a thriving and happy activity.

"So great and so powerful is the influence which a good system of internal communication has over the wants and the comforts of social society, that one can scarcely cast an eye on improvement in travelling, but matter for encouragement springs up in luxuriant abundance. Our political sages inform us, that unless we have the benefit of a plague, or of some such serious calamity, to thin the ranks of our growing population, we shall presently elbow each other from the means of existence. It is really amusing to see how far into the regions of chimera men wander, uncurbed by thought or reflection. Have these ominous predictors of misfortune never glanced at the 'march' of invention?—have they never considered that want and improvement are the younger twin-sisters of wealth? It is scarcely a century since that horses bore all our commercial productions on their backs. Hardly coaches or carts at that time were known as modes of distant conveyance. As wealth however increased, wants grew in proportion, and invention kept pace with them both. That which had been saddled by our fathers on the backs of their steeds, necessitous improvement taught us to tack to their heels. Had some such contrivance as this not occurred, in what situation now should we be? All England could scarcely find land to support the horses we should want for our use. Even Europe itself, were commerce to march with the same rapid step for a century more, with which it has gone for the last twenty years, would scarcely grow food for the horses which England alone would require.* Instead, therefore, of croaking and grumbling, and preferring to exuberant blessings the direst of all

* If stage-coaches have increased in all parts as they have in some of our larger towns for the last twenty years, there are four or five times as many more as there were then. Norwich, I am informed, less than twenty years ago, had only five coaches; now it has twenty-two or more. Bristol and Bath, I believe, have made nearly equal strides in coaching.

a plague or a famine, let us copy
dom of our fathers, and look to
ources of art. Our ancestors, to
t further increase of horses, or
nish the number they had, con-
heir coaches and waggons; and
ould not we, for a similar pur-
ay aside our dismal forebodings,
re recourse to another invention?
ger does really beset us from
pulation, of which, however,
race is best judge, then it would
be invention of steamers adds to
the merit of being a happy relief
wants most admirably timed.
ain, let us but think of the effect
have on our rank and power as
n. It is generally supposed, as I
eretofore mentioned, that the
employed in staging and posting
e land enough to maintain dou-
treble our present population.
land be taken for our use, it is
t to infer, from the experience of
, that our population will increase
portion to the means of support.
we are already, as our politicians
us, among the most powerful of
, what should we be, or what
re not do, with the revenue and
f a doubled or trebled popula-

the score of humanity, too,
something to be said for the in-
tion of steam. Commercial exi-
begin to require the utmost des-
Horses to meet it are pampered
, and strained and forced to ex-
far beyond what their natural
h can support. The consequence
their lives are contracted to a
r a fourth of what nature allots
while hundreds, perhaps thou-
are annually destroyed by the
ral efforts to which they are com-
And with all this barbarous
f our power, what have we at-
?— aspeed scarcely the double of
hich a man can compass by walk-

JUNCTION RAIL-ROAD, TO JOIN THE LIVERPOOL AND MANCHESTER RAILWAY, AT NEWTON.

(*From the Liverpool Chronicle.*)

ves us pleasure to announce that
irable union of a rail-road from
to join that between Liverpool
nchester, at Newton, is about to
nce; the Company is already
, and the required number of
subscribed for, chiefly by inhabi-
f Wigan. The capital required
£40,000, to be held in shares of
ach. *Mr. Vignoles, who laid* out the main line from Liverpool to Manchester, is appointed principal engineer; and Messrs. Battersby and Bankes, of Wigan, solicitors to the Company. The greater part of the landowners, on the proposed line of road, have already assented to the plan; and no line of railroad, hitherto projected or formed, presents so many advantages, and so few natural obstacles in the completion. The distance by canal, from Wigan to Liverpool, is 35 miles; by the high-road, 22 miles; whilst the distance by the railroad will be barely 23 miles. The distance from Wigan to Manchester, by canal, is 22 miles; and for only going over 14 miles of that distance, the Duke of Bridgewater's trustees charge 3*s.* 8*d.* ₰ ton for coals and other merchandise, which operates as a complete exclusion of the Wigan coal from the Manchester market: the distance to Manchester by the proposed railway will be 21 miles, and by the present high-road it is 19 miles. The elevation upon the Wigan Railway will in no part exceed 12 feet to the mile, which to the naked eye will present nearly a dead level; and it most singularly happens, that the line will reach within 130 yards of the market-place, without the necessity of taking down a single house on the whole line of road. The imports into Wigan from Liverpool are cotton, corn, and groceries, to a very great amount: the exports from Wigan will be cannel and coal; and the proposed line of railroad will pass over a space of four miles at least, abounding with rich veins of coal, besides receiving by branches the coal, &c. from most of the mines in the vicinity of the town. The carriage of passengers by coaches has of late years greatly increased; and there are now three daily coaches, and one mail-coach, to and from Liverpool—one daily coach to Manchester, besides extra market coaches. We congratulate the gentlemen of Wigan on their spirited enterprise, and we trust the town of St. Helen's will follow their example, that branch alone being wanting to complete the entire connection of all our manufacturing towns with Liverpool by railways.

OCCULTATION OF ALDEBARAN, ON THE 15TH OF OCTOBER, IN THE EVENING; OBSERVED AT EPPING, LATITUDE 51° 41′ 41·6″ LONGITUDE, ABOUT 27″ IN TIME EAST OF GREENWICH.

Sir,—In the early part of this occultation, the moon was in some degree

partially obscured at intervals by a *cirro-stratus* cloud of variable tenuity, which, contrary to the usual effect of this modification in its more advanced state of formation, proved rather advantageous than otherwise to the eye, by taking off the glaring light of the moon, without vitiating the observation in the least. On the near approach of the star to the moon, its motion seemed to become irregular, and a few seconds before its *immersion* appeared to attach itself to the illuminated limb of the moon, when, throwing out a scintillating ray, it instantly disappeared. At the *emersion*, the star burst into view in its full splendour from the dark part of the moon.

The M. S.T. of immersion was at 9h. 12m. 53s., and that of emersion at 9h. 49m. 58s., making the duration =37m. 5s. Now, what is the radius of curvature at this place to produce the above result?

It is evident that the absolute time of immersion at *Epping* was later than at *Greenwich*, and on the whole the duration at the former place must have been less than at the latter. The error of the clock was ascertained, as on a previous occasion, by correct altitudes of the sun taken with the reflecting circle.

An achromatic telescope with an astronomical eye-piece, and power of 80, was used for observing the immersion and emersion.

That in lunar occultations of this, and other stars wherein the red rays predominate, they appear to be projected on the light disc of the moon near the time of immersion, *is evidently owing to the difference in the refrangibility of the rays of light*; those of the white light of the moon being greater than the red light of Aldebaran and similar stars.

As the light of *Spica Virginis* has nearly the same refrangibility as that of the moon, it would be curious to know what appearance this star makes in an occultation about the time of its immersion and emersion. In this case, would not the star disappear or reappear at the moment its direct visual ray became a tangent to the moon's limb?

I remain, Sir, yours, &c.

THOMAS SQUIRE.

Epping, Oct. 22, 1829.

EXTRACTS FROM MY NOTE-BOOK.

NO. II.

On the Revolution of the Moon on its Axis.

(Continued from p. 814.)

ALL astronomical writers inform us, that the earth in its annual revolution preserves the parallelism of its axis.

But though I have attentively searched several works on astronomy, I have not found that any of them, with the exception of the London Encyclopedia, art. Astronomy, say, that all the planetary bodies also preserve their parallelism. This is an omission much calculated to mislead the astronomical student.

The fact that the moon constantly presents the same face to the earth has been considered a proof of its revolution upon its axis. Now, by fig. 1, it is evident that the same face is presented during the whole period of the orbicular revolution, although there is no revolution upon the axis. But in fig. 2, where the parallelism of the axis is preserved, we see that there must be a revolution upon the axis, and *that* in the same time as that in the orbit, in order that the same face may be presented. A represents the earth, *e e*, the moon's orbit, *s s s*, the moon's axis.

Fig. 1.

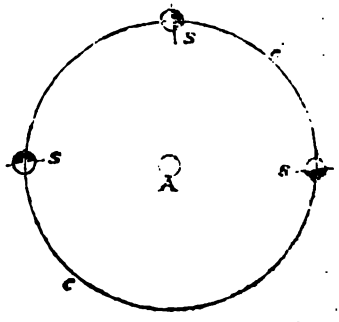
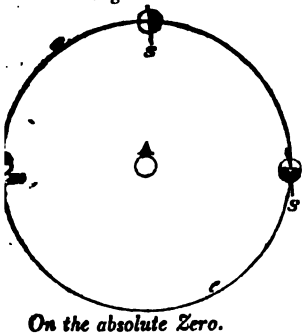


Fig. 2.



On the absolute Zero.

s not my intention to examine orem of Irvine for ascertaining int of absolute zero, or to in- into the cause of the great dif- e which exists between the re- obtained by those philosophers ave attempted to determine it by ment, but to point out the fal- f the reasons assigned by Dulong etit, and other modern philoso- for placing it at 448° Fahr.

t appears by the experiments of L. Gay Lussac and Dalton, that es and vapours, of whatever na- when not in contact with liquids, fected equally in their volume anges of temperature; the in- in volume for every additional f of heat of Fahr. scale being $\frac{1}{480}$ part of the volume at 32° Fahr." —Farraday's Manipulation, p. 376.

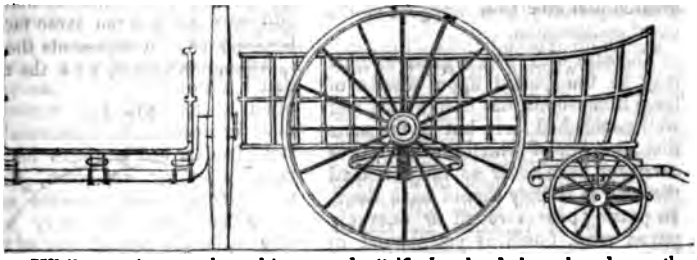
Hence it has been argued that since a reduction of the temperature of a given volume of gas to 480° below 32° Fahr. would annihilate all bulk, the point of absolute zero cannot be lower than 448°. Those who have advanced this opinion seem to have forgotten that bodies by a reduction of temperature pass from the gaseous to the liquid state, and from the liquid to the solid. Therefore, steam which at certain temperatures obeys the gaseous law of expansion, becoming fluid below 212° Fahr. obeys an entirely different law; a farther reduction of temperature causes solidity, and another law is obeyed. The same holds true with regard to many other gaseous fluids, both those called vapours and those improperly called *permanent* gases. And though there are some gases which have not been liquefied, yet it would be a most gross and absurd violation of analogy to suppose that they preserve their peculiar, that is, gaseous form, up to the point of a pretended absolute zero.

I shall perhaps in some future communication inquire into the possibility of an absolute zero, but my object here is only to show that we have no reason for placing it at 448° Fahr.

(To be continued.)

IMPROVEMENT IN WHEEL-CARRIAGES.

Fig. 2. Fig. 1.



—While treating on the subject eel-carriages (in answer to an in- by a correspondent) at page 12, ur tenth volume, I stated, that one will, I believe, deny that a n or other carriage on four s of equal diameter, is of lighter ht than those in common use, the fore pair of *wheels of less ter than the hind;*" *but, I* added, "if the load be placed on the fore and hind-wheels, in the same proportion that their diameters bear to one another, nearly all the advantages of having wheels of equal diameter will be obtained." On pursuing this subject, it occurred to me, that this proportioning of the load could not at all times be effected in carriages of the ordinary description, even if wished;

because the body of the vehicle must be equally filled with the goods to be removed, or a great loss of room would occur. I was therefore led to consider some plan for the construction of vans, waggons, &c., in which the load should be so judiciously distributed between the wheels, as to render the difference in their size a matter of no importance; and this without any attention on the part of the person loading such vehicle.

The accompanying rough sketch, fig. 1, will exhibit the manner in which I propose to obtain this desideratum. In this which is a side section of a light waggon or van, mounted on springs, the fore-wheels are of the usual size, that is, as large as will admit of their locking under the body of the carriage in turning.

The hinder wheels are unusually large, and are so situated, as to carry four-fifths of the weight when the body is fully loaded; with less than a full load they may be made to carry the whole weight, by placing it over them. To admit of such large wheels being used, the axle is bent, as will be better seen by referring to fig. 2, which is a section of the hinder portion of the carriage; it will also be seen that this part of the carriage is supported by three springs, two only being used in the fore part. Simple as this arrangement may at first sight appear, it will be found to possess a great superiority over waggons of the usual construction.

The ease with which great weights may be transported upon wheels of large dimensions, has been a long and well-established fact: but at the same time, it is one of which the builders of carriages have never so fully availed themselves as they should have done. In passing over a rough or unevenly paved road, (such as yet abound in many parts of our metropolis) a small wheel sinks into every little hollow, and the axle, if noticed, would be found to describe a line almost as curved and irregular as the surface of the road. A large wheel on the same road would partake but slightly of its inequalities, and the line described by *the axle would* be found to deviate *but little from* a straight line; indeed, with a wheel sufficiently large, the axle would describe a perfectly straight line; in the latter case the friction and consequently the draught would be little more than if the carriage ran upon a rail-road.

The larger therefore we use the wheels, the nearer we approach this favourable point of effect. It has been advanced as an objection to the use of large wheels, that they add greatly to the weight of the vehicle; that they do so, I will not deny; but on the other hand, the advantages which large wheels have over small ones are so very great, as to much more than counterbalance the trifling increase of weight. Several other objections have been made; but these as well as the former have been almost wholly removed, by the introduction of the patent metal wheels of Messrs. Jones and Co.: a full description of which will be found at p. 209, of your ninth volume.

I have attempted to represent this form of wheel in the prefixed sketch, because I am very certain, that no person attempting to improve the construction of wheel-carriages would use any other; they are now very extensively used in vehicles of almost every description. I must beg leave to observe, that I lay no claim to originality in the use of the *bent-axletree;* because that arrangement has been long employed in gigs, fire-engines, &c., by which means, wheels of a considerable size have been used, without raising the body to an inconvenient height.

This principle, however, is also one that has not been so extensively applied as its advantage merits. We find, for instance, that brewers' drays, stone trucks, and carriages for the removal of large iron-work, &c. &c., which carry most immense weights, are placed upon the very smallest wheels, for the convenience of loading and unloading. By the application of the bent-axle, large wheels, so highly necessary in these cases, might have been employed without raising the body of the carriage. I flatter myself that the removal of the greater portion of weight from the small fore to the large hind-wheels, will be found to answer in a perfect manner all the purposes of using large fore-wheels—

ct to which carriage-builders
ıerto directed their attention.
nclusion, permit me to say,
:rfectly coincide with the opi-
the writer of the article on the
arriage-wheels (R. C. Jun.) in
1st Number, that the solutions
roblem, at p. 439, vol. ii. are
eans so conclusive as the gen-
rho furnished them may have
1. I may observe, that they
ısider the traces as attached to
of the wheel, which is never
By varying the point of at-
ıt, therefore, the line of draught
e horse's collar may still be
erpendicular to the line CO
p. 439) with wheels of either
less than two feet radius.

I am, Sir,

Respectfully yours,

WM. BADDELEY, Jun.

, 1829.

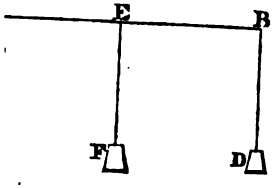
ON DR. LARDNER'S LECTURES
ECHANICS, AT THE LONDON
RSITY.

(Continued from page 109.)

y number of given forces act on
mber of given points in the
ane, it is required to determine
fect will be produced?
the following propositions all
ces are supposed to act on an
le rod, the weight of which is
en into account.)

.—Let there be two equal forces
on different points of the same
nd in parallel directions, it is
d to determine what their me-
l effect will be, or in other
what single force will produce
e effect?

Fig. 1.



the line AB (fig. 1) represent
ly on which act the two equal
or weights C and D in the
ns AC *and* BD.

Now a weight (F), double C or D acting on a point (E) equidistant from the two given weights, and in the same direction, will produce the same effects as the two forces C and D acting together from the points A and B.

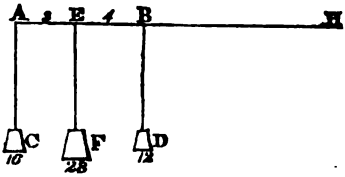
It is of no consequence how great be the distance between the given forces so long as the single force is exactly equidistant from both of them.

Secondly.—Let the two forces be unequal, it is required what is the single force productive of the same effect?

There are two things to be here determined; viz. the magnitude, and the place of the required force.

With regard to its *magnitude*, it is evident that it must be equal to the sum of the two given forces.

Fig. 2.



Let the line AB (fig. 2), represent the body to be acted upon by the unequal weights or forces, C and D, (viz. C=16 and D=12) hanging from the points A and B; consequently the required force will be (16+12=) 28.

With regard to its *place*, the distance between each given weight and that required, must be proportional to the opposite weight. Thus supposing that the distance between A and B be 7 inches, then the point E, on which the required weight F acts, should be distant from A 3 inches, and from B 4 inches, because as C:EB::D:EA, or as 16:4::12:3, therefore a weight F= 28, hanging from a point E at these distances, will be equal in effect to the two (C and D) together.

These distances can also be found by common arithmetic. The rule is—*multiply the weights by their distances from any point in the place beyond those on which they act, the sum of which products, divided by the sum of the two weights, will give its distance* from that *point*. Thus, as in the last figure, let the distance AH be equal to 18 inches,

and BH to 11 inches, then it will be

$$\frac{C \times AH + B \times BH'}{C + D} = EH \text{ or}$$

$$\frac{16 \times 18 + 12 \times 11}{16 + 12} = \frac{420}{28} = 15 \text{ inches.}$$

the distance from the point H at which the weight F must act.

This rule will serve for finding a single force equal in effect to any number of given forces in parallel and the same directions.

(To be continued.)

COPE AND SHERWIN'S NEW PRINTING PRESS.

Sir,—In No. 320 of the "Mechanics' Magazine," I observe a communication from a Correspondent headed "Cope and Sherwin's New Printing Press." I do not consider it my duty to say any thing on the merits of the press; let the trade judge for themselves; but as particular mention is made of the mode of adjusting the pull, I beg to say the improvement is borrowed from me. I introduced it in the late lamented Mr. R. W. Cope's Albion, before Messrs. Cope and Sherwin's press was thought of; and if you agree with me, that it is only just for those who win laurels to wear them, you will insert this communication, and oblige,

Sir, your most obedient servant,
J. HOPKINSON.

14, *New North Street, Finsbury,*
Oct. 9, 1829.

MISCELLANEOUS.

Volatile Oil.—At a time when locomotive engines are likely soon to be found traversing all the populous districts of the country, it becomes highly desirable that these moving furnaces should be so heated as not to annoy the inhabitants with a never-ending stream of smoke, and we have the pleasure to find that this *desideratum* can now be effectually attained. In the manufacture of resin and oil gas a large quantity of volatile oil is collected. This combustible liquid is now used instead of coal at the oil gas-works in Leeds to heat a bench of four retorts, which generate 600 feet of gas per hour; and the heat is kept up during the day without the slightest variation, with two gallons of the volatile oil per hour, giving out neither the least smoke nor smell. The advantages of this discovery for the use of locomotive engines it is *scarcely possible to* appreciate; and it is not *amongst the least* of them, that two gallons of the volatile oil, weighing only 16lbs., will produce as much heat as 112lbs. of coal or coke, thereby diminishing the weight of fuel to be carried seven pounds in every eight.—*Leeds Mercury.*

Naval Architecture.—From two draughts that have been presented to Sir Robert Seppings by Admiral Greig, two frigates of 60 guns have been built in the Black Sea, with a view to ascertain, by actual experiment, the truth of the principle as laid down by Romme, the great French author on ship-building, viz. that the resistance the body meets with depends chiefly on the area of the greatest transverse section. The frigates are each about 171 feet long, and 44 feet broad. Their submerged part is a mathematical figure formed from the parabola; and the midships, and other transverse sections, with waterlines, are parabolas of different exponents. Both bodies have the same area of flotation and displacement, with the centre of gravity of displacement, and other elements of construction in the same relative position, but one has a much larger area of midship section than the other.—*Hampshire Telegraph.*

The main-mast of the *Briton* has been fitted with a tin pipe, for the conveyance of the voice in boisterous weather from the quarter-deck to the main-top. The pipe is about one inch in diameter. It is a proposition of Mr. Parsons, of this dock-yard.—*Ibid.*

Woollen Manufacture.—A French paper (*Le Constitutionnel*) states, that the manufacturers of Elbeuf and Louviers have discovered and adopted a mode of preparing woollen cloths without oil, or any description of grease—thus rendering the manufacture more cleanly, wholesome, and economical. The *Constitutionnel* adds, that the cloth prepared according to the new process is as soft, and in every respect as good, as that made upon the old system.—*Literary Gazette.*

INTERIM NOTICES.

In our next Number we shall give a drawing and description of a Safety Railway Carriage, designed by Mr. G. Wilson.

We beg to refer such of our Readers as may think with "B", that we are occupying too much of our pages with Railways and Railway Carriages, to the developements given in our present Number of the vast influence which they are likely to exercise on society. We trust, however, that "B" is singular in his opinion.

The Liverpool Paper from which we made the extract in our last Number (p. 146), was not, as there inadvertently stated, the *Mercury*, but the *Chronicle.*

If "An Old Subscriber" will state the case in question a little more distinctly, he shall have an answer.

We have forwarded Mr. Bickmore's letter to the S. P. I. F.

Communications received from Mr. Ottywil—Mr. Gilbert—Mr. Reed—Mr. Squire—A Mechanic—△—Mr. Baddeley—Mr. Watson—C. H.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

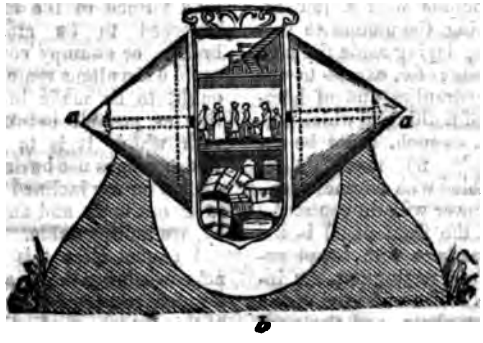
No. 326.] SATURDAY, NOVEMBER 7, 1829. [Price 3d.

" I had a dream, which, in my waking hour
Seem'd less the work of fancy's airy power
Than reason's deep creation."-- DRIVER.

SELF-MOVING RAILWAY CARRIAGE.

Fig. 1.

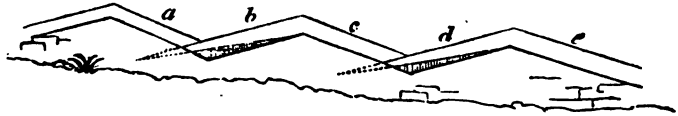
Fig. 2.



SELF-MOVING RAILWAY CARRIAGE.

Sir,—In treating of perpetual motion, "that grand secret for the discovery of which, those dictators of philosophy, Democritus, Pythagoras, Plato, did travel unto the Gymnosophists, and Indian priests," it would add considerable interest to give some account of its early history. But by so doing we should be carried deeper into this mazy subject than is necessary to our present purpose. Regarding the fallibility of every contrivance hitherto planned or experimented upon, we may gather sufficient proof from the writings of Bishop Wilkins alone. The "little world" of Paracelsus and his followers—the planetarium invented by Cornelius Drebble for King James—the "magnetical globe or Terella" suggested by Pet. Peregrinus, with the wheel that he, Taisner, and Cardan, thought might be kept in motion by "pieces of steel and loadstones"—are, like the Bishop's own wheel and plummets, and his application of Archimedes' screw, inadequate to the grand end for which they were designed. Without, therefore, enlarging on this head, we shall proceed with the description of a machine, which, were it possible to make its parts hold together unimpaired by rotation or the ravages of time, and to give it a path encircling the earth, would assuredly continue to roll along in one undeviating course, till time shall be no more.

A series of inclined planes are to be erected in such a manner that a cone will ascend one, and being raised to the summit, descend on the next, at the foot of which it must rise on a third and fall on a fourth, and so continue to do alternately throughout. In the following diagram are shown the inclined planes *a*, *b*, *c*, *d*, *e*.



A conical figure would run up *b*, or *d*, and descend at *a*, *c*, or *e*; for it must be observed, that the sides of the first-mentioned inclined planes form acute angles, while those of the second have their sides parallel to each other. To make a circle of railroad on this principle round the earth is quite impossible; and whether a lesser one would answer is questionable, as it would be no easy matter to proportion the cone to suit the inner and outer circles of the inclined planes.

I shall conclude with a few remarks on turning the motion to profitable account, laying aside the idea of its perpetuity; for, except to the purposes of hydraulics and of horology, I know of nothing to which perpetual motion, as such, could be applied: certainly no manufacturer would be troubled with engines exerting all their power without controul.

Fig. 2, (on the front page) is the section of a carriage with broad conical wheels *a a* resting on the inclined plane *b*. The entrance to the carriage is from above, and there are *ample accommodations* for goods and passengers. It is ballasted by placing the heaviest packages at the bottom; a necessary precaution to prevent the body of the carriage from swinging over. The most singular property of this contrivance is, that its speed increases the more it is laden, however great the distance may be; and when checked on any part of the road, it will, when the cause of stoppage is removed, proceed on its journey by the mere power of gravity. Figure 1, represents a portion of a circular road formed of the inclined planes, supposed to be crossing uneven, broken, or swampy country. But to avoid a circuitous route, a double road ought to be made in as straight a line as possible between the places with which it is to communicate. The carriages not having a retrograde motion on the inclined planes, a road to set out upon, and another to return by, are indispensable.

I cannot close this letter without acknowledging that I am indebted to a much respected friend for the hint of this means of effecting a veritable perpetual motion; he likewise had it

from others, so that it would be impossible to say with whom the idea originated.

I remain, Sir, yours, &c.

Finsbury, Oct. 1829. HENRY D—.

[The preceding communication bears a strong analogy to a speculation which we met with a few days ago in a pamphlet on railways by Mr. Charles Sylvester, Engineer.* As it is contained in few words, and may serve to illustrate the principle of our ingenious correspondent's plan, it is here subjoined:—

"With a view to make these principles (of moving wheel-carriages along railways) better understood, I will propose an hypothetical plane or railway destitute of friction, to go quite round the earth, keeping every portion of the surface of the rail the same distance from its centre. These would be the precise data to constitute a level plane. It will be clear to all who are acquainted with central motion, that if a carriage or other body be put in motion upon this hypothetical plane with any given velocity, it will continue to revolve round the earth with the same velocity, supposing it to have no friction, nor to be otherwise resisted. This hypothesis being admitted, I will now suppose what we shall all readily allow, that this plane has a certain but uniform friction throughout, and that in order to overcome this friction, we will suppose it to have some power travelling with it for that purpose. This being effected, it will I think be granted that whatever force we add to that which overcomes the friction, the carriage will be put in motion, and its velocity will increase equally in equal times as long as this extra force is continued. If at any period of its motion this extra force be withdrawn, leaving that still in action which balances the friction, the body will go on with the velocity it had acquired, and if the path reached round the earth it would continue to revolve for ever."]

* Report on Rail Roads and Locomotive Engines; addressed to the Chairman of the Committee of the Liverpool and Manchester Rail-road. *Liverpool, 1825.*

MESSRS. BRAITHWAITE AND ERICSSON'S STEAM-ENGINE.

[We regret that our ingenious contemporary, Mr. Hebert, should have exposed himself by what we conceive to have been a hasty expression, to the animadversions contained in the following letter. But when the very injurious effect which any mis-statement under his respectable authority must have on the credit of an invention is considered, it cannot be thought surprising that the parties affected should feel warmly, and express themselves with (perhaps) some exaggeration on the subject.—ED. M. M.]

Sir,—On reading in the *Morning Herald*, of Tuesday last, an extract from the "Register of Arts," containing an account of a new steam-carriage patented by Sir James C. Anderson, Bart. and W. H. James, Esq., I was not a little astonished to find it stated in the form of a foot-note to the article, that "there can be no question it was the blast upon Messrs. Braithwaite and Ericsson's boiler which caused it to give way, and let water into the furnace;" meaning, at the late competition on the Liverpool and Manchester Railway. I concluded, of course, that Mr. Hebert, the Editor of the "Register," could not possibly have seen the Number of the "Mechanics' Magazine," in which it was clearly shown there was no giving way of the *boiler* at all, in the case of "The Novelty," but a yielding of part of the furnace-flue, in consequence of its being accidentally exposed to a dry heat of high temperature, and that "the blast" had nothing whatever to do with the accident, which would have been equally certain to happen had there been no blast in the case. Your readers may judge, however, what my surprise was, when on sending for the Number of the "Register" itself from which the above extract was taken, I found three-fourths of it filled with quotations from your interesting account of the late competition and the competing engines, including among these quotations the very explanation which ought to have prevented the egregious misrepresentation transferred from the pages of the "Register" to the Herald. The correct-

mess of that explanation is not once disputed by the Editor of the "Register;" nor could he, with any regard to truth, have impugned it in the slightest degree. Yet in the teeth of his unquestioned and unquestionable explanation, he has elsewhere the hardihood to affirm, "there *can be no question* it was the blast," &c.! "No question!" Mr. Hebert knew well that a question had been raised on the subject, but completely set at rest by the explanation given in your work, and copied from it into most of the journals of the day.

The motives which have led Mr. Hebert to hazard so gross a perversion of the truth are easily to be traced. Sir James Anderson and Mr. James are patentees of a steam-engine in which the tubular plan is carried to such an excess, that the tubes of one of two horse power extend the moderate length of 430 feet!!! Mr. Hebert is, as he states, "professionally engaged" for these gentlemen; and it is the obvious interest of all parties concerned in or connected with that engine to make it appear to the public that tubular boilers are the best of all possible boilers, and every other plan of generating steam more or less inefficacious and dangerous.

It is not accordingly the *blast* alone which Mr. Hebert finds fault with in the construction of "The Novelty," and endeavours by misrepresentation to bring into disrepute. "The great steam-chamber A" is also with him a source of prodigious alarm, although such chambers are common to all high-pressure engines, as well as "The Novelty;" and the one in "The Novelty" is one of the *smallest* ever known, being at least three-fourths less than the steam-chambers of "The Rocket" and "Sans Pareil." The gentleman even calls for legislative interference to protect the public from the "catastrophes" which he asserts "are sure to happen" from the use of "great steam-chambers" like the little great one of "The Novelty;" that is, in plainer language, for an Act of Parliament to prevent all persons from using any other than the four hundred and thirty feet generating tubes of *Mr James Anderson, James, Hebert, and Co.!!*

Whatever private interests Mr. Hebert may have to serve, he ought, as a man of science, and the editor of a scientific journal, to be ashamed of such palpable subserviency. Years have gone by since it was left to ignorance and prejudice to wage war against the employment of high-pressure steam-engines. Mr. Hebert must know well, there is no danger connected with them which cannot be effectually guarded against; and he has acumen enough to perceive (if he would but exert it conscientiously) that the blast, which he abuses so much, does in fact lessen that danger, instead of augmenting it; since, in proportion to the quickness with which steam can be generated, must the necessity of having a large store in reserve be diminished.

I might say much more in illustration of Mr. Hebert's candour and impartiality; but having vindicated myself and partner, and our engine, from his illiberal aspersions, and pointed out the source of these to a discerning public, I have no desire to trespass farther on your pages.

I remain, Sir,
Your obedient servant,
JOHN BRAITHWAITE.

1, *Bath-place, Fitzroy-square, Nov.* 4, 1829.

CONTINUATION OF THE EXPERIMENTS ON THE LIVERPOOL AND MANCHESTER RAILWAY—COMPARATIVE CAPABILITIES OF COMMON ROADS, CANALS, AND RAILWAYS.

We are glad to learn that the locomotive experiments on the Liverpool and Manchester Railway have not ceased with the winning of the prize recently offered by the Directors, but that every day some new trial is made, and some new result obtained, which serve to render more conspicuous than ever the vast capabilities of steam-carriages when employed on railways.

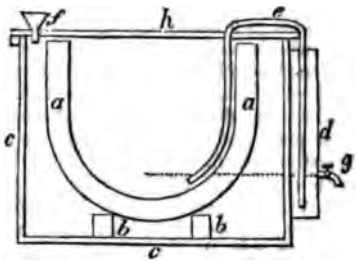
On Saturday last Mr. Stephenson's engine, which has received several material improvements since the late competition, exceeded all its previous performances in an extraordinary degree. It drew after it, on a dead level, 40 tons, at an average rate of 14 miles an hour, being more than three times

the weight which it drew at the rate of 12½ miles per hour when competing for the prize. It afterwards drew 18 tons up a plane, having an inclination of 1 in 96, at the rate of 8 miles an hour.

"The Novelty" had not, at the date of our last advices from Liverpool, made its re-appearance upon the railway, but it was expected to exhibit again before the close of this week.

Although we attach great importance to the continuation of these experiments, and to the results they have furnished, and are likely to furnish, we would not have our readers suppose that we do so because science has much to learn from them. Facts such as those we have recorded respecting the power of steam-carriages on railways, are "extraordinary" only in relation to the state of popular belief on the subject; and valuable only in as far as they serve, more than all the theorizing in the world could do, to rectify and enlighten that belief. Nothing has been achieved on railways, as far as power and speed are concerned, which was not previously shown by men of science to be perfectly attainable; nor can locomotive practice ever reach a point where it will not see a signal-post erected by theory many leagues in advance of it. What steam-carriages can do on railways—whether these railways are level or inclined—has been always as much a matter of positive calculation as any other power or effect within the range of mechanical philosophy. We had prepared some elucidations on this head for insertion in our present Number, but having received an intimation from an esteemed friend and contributor, who has paid particular attention to the subject, and witnessed, like ourselves, all the recent experiments at Liverpool, that he has something of similar import in hand, which he hopes to be able to send to us in a day or two, we feel bound in courtesy to withhold our own elucidations for the present. The paper of our friend "will be devoted generally to a calculation of the power requisite on railways; and contain a table, showing what that power should be at every velocity, and at various degrees of inclination, from *9 to 50 feet per mile.*"

STONE-FILTER.



Sir,—Above I hand you a sketch of a filtering apparatus, which I invented several years ago. The advantages attending it are, that the water passing *upwards* through the stone *aa*, leaves in the cistern *c* all such impurities as are heavier than the water, whence they are easily removed. By these means the stone never wants cleaning out. The syphon *e* enables a supply to be drawn out at the cock *g* at any time, while there is water in the cistern; to fill which a funnel *f* is inserted in the lid or cover *h* of the cistern, and the pipe *d*, into which the syphon dips, always keeps the syphon ready for action: *bb* are stands for the stone to rest upon. The cock *g* must be fixed a little above the highest end of the syphon, the legs of which may be of the same length.

I am, your humble servant,
and constant reader,
BENEVOLO.

July 18, 1829.

ON THE ADVANTAGE OF LARGE WHEELS IN RAILWAY CARRIAGES, AND THE MEANS OF ASCENDING INCLINED PLANES.

Sir,—The advantages derivable from the use of wheels of large diameter, seem to have been strangely neglected in all carriages used upon railways, the wheels of the engines being generally less than 4 feet, and of the loaded carriages less than 3 feet diameter. To convey some notion of the amount of these advantages, I shall give the result of two experiments made by Mr. Wood, the details of which are given in his Treatise on Rail Roads.

A locomotive engine mounted on wheels of 3 feet diameter, drew after it 9 loaded waggons weighing 731 cwt. 36 miles in 9 hours and 35 minutes: the wheels were then removed and replaced by others of 4 feet diameter; and with this single alteration the engine drew the same load 48·8 miles in 9 hours and 27 minutes, the consumption of fuel being the same in both cases, viz. 2534lbs.: hence, as Mr. Wood observes, if the load and the consumption of fuel be the same, the space passed over in a given time will be as the diameter of the wheels for 3 is to 4, as 36 to 48, and also *by enlarging the diameter of the wheels of the engine the velocity is increased, and the consumption of fuel diminished at the same time*: for if we suppose 36 bushels to have been consumed in each experiment, the expense per mile will be one bushel in the first experiment, and only three-quarters of a bushel in the second; whilst the velocity in the first experiment was 3·7 miles per hour, but in the second 5·15 miles per hour.

Although from the great scale on which the experiment was made, and the time it occupied, it is decisive upon the subject: the result has certainly an air of paradox, for there appears to have been a gain of power and velocity at the same time; and as the wheels may be supposed of any diameter, it may seem to prove that the mechanical effect of a given power may be indefinitely increased, and consequently exceed the power expended; but if we examine what is the real mechanical effect in moving a carriage along a horizontal plane, the air of paradox will disappear, and it will be seen that the result of the experiment is in accordance with the laws of motion.

The resistance to the motion of wheel-carriages (independent of that caused by the air) may be divided into two parts, that at the rim and that at the axles; the resistance at the rim is occasioned by the inequalities of the surface on which the carriage travels, the whole weight of the carriage requiring to be lifted through the perpendicular height of each obstacle, and of course requiring a force to be *exerted equal to its own* weight, moving *through the same* space. But in a well-laid horizontal railway of good construction, the resistance at the rim of a perfectly circular wheel is so very small, that we may in practice consider the resistance at the axles as the only obstacle to the motion of the carriage.

The resistance at the axles is the friction of the wheel during their revolution on the axle, and the amount of this friction in any given time will depend upon the weight with which the carriage presses the axles; and the space through which this pressure acts, and the amount of friction overcome in any given time will be the real measure of mechanical effect in that time; therefore if the weight of the carriage be always the same, and the wheels perform the same number of revolutions in any given time, the friction or mechanical effect will always be the same, and will only require the same expense of power; but the space through which the wheels roll at each revolution on their axles will be as their diameter, and if the revolutions be made in equal times in all cases, the horizontal velocity of the carriage must also be as the diameter. Thus it will be seen that the real measure of effect in transporting carriages along a horizontal plane, is as the pressure at the axles multiplied by the number of revolutions, and not as the weight of the carriage multiplied by the space through which it passes, as would be the case if the carriage moved in a vertical instead of a horizontal path. If the plane be inclined, then in addition to the friction of the axles there is the gravitating power of the load to be considered, which will be as the weight of the carriage and the perpendicular height of the plane; and as it is only the friction at the axles which is reduced by increasing the diameter of the wheels, the increase of velocity will not be as the increase of diameter, but as the increase of diameter divided by the proportion which the friction bears to the gravitating power of the load. Thus, if it require a force of 16 cwt. to overcome the friction of a carriage on a horizontal plane, the carriage weighing 10 tons, it will require to move the same carriage up an inclined plane, 100 feet long, with a rise of 2 feet, an additional force of 10 tons

moving through 2 feet, or 2 cwt. through 100 feet; and the whole force required will be 3 cwt. through 100 feet. Moreover, as the friction is only $\frac{1}{4}$ of the whole resistance, the increased velocity obtained from increasing the diameter of the wheels is only $\frac{1}{4}$ of what it would be on a horizontal plane.

Another advantage which large wheels possess over small ones is, that they are less liable to slip or turn round on the rails without advancing the carriage; and this advantage Mr. Wood has wholly overlooked, for in his experiments to ascertain the amount of adhesion of the wheels to the rails, he states it to be $\frac{1}{16}$ of the weight of the engine, without adverting to the size of the wheels. Now the adhesion evidently depends upon the weight of the carriage and the diameter of the wheels jointly, for the force with which the circumference of the wheel is pressed by the carriage against the rail, may be considered as a weight acting at the end of a lever, whose length is the radius of the wheel, and the resistance will be as the radius is to the length of the crank by which the wheel is turned: or, as the amount of friction is as the pressure and as the space through which it acts, the friction of the wheel in slipping during any portion of a revolution will be as the diameter of the wheel; therefore the *weight* of the engine may be diminished or the weight of the load to be drawn may be augmented, if the diameter of the wheels be increased, provided the *power* of the engine bear always the same proportion to the load.

The superiority of large wheels over small ones being so evident, I have no doubt that in future attempts at improvements on locomotive engines greater attention will be paid to this point, and that the diameters will be increased as far as is consistent with strength, and without adding too much to the weight; and the limits in this case will I think be best attained by wheels on Mr. T. Jones's construction, which may now be had formed entirely of wrought iron, and which far exceed in lightness and strength any wheels hitherto employed on railways. What *these limits may be is hard* to say, but it seems not too much to expect that wheels of 8 or 9 feet diameter may be employed; for the wheels of timber waggons and also of the French diligences are frequently 6 feet in diameter, although made of wood, and exposed to great transverse strains from the inequalities of the road. Eight feet therefore does not seem to me too great a diameter for iron wheels upon a railway, and exposed to no transverse strain; and the stability might be rendered even greater than at present, as the diameter would admit of the boiler and the rest of the apparatus being placed below instead of above the axles.

There is another point to which I would advert, viz. the means of ascending a plane, the acclivity of which is too great to be overcome by the adhesion of the wheels: in this case the carriages are in general hauled up by a rope wound round a barrel turned by a fixed steam-engine; but the friction of the rope along the plane, although supported by friction-rollers, amounts in many cases to nearly one-third of the whole resistance, whilst in most cases the ascent might be surmounted by either of the following methods:—1st. By means of a toothed-rail along the whole length of the inclined plane, into which a toothed-wheel attached to the locomotive engine works, as on the Middleton Colliery Railway at Leeds. Or, 2nd, by means of a chain extending the whole length of the plane, and made fast at each extremity, and a spike-wheel attached to the locomotive working into the links of the chains: for this method Mr. Chapman has a patent, if it be not expired. By either of these methods the friction beforementioned wouldbe avoided, and fixed engines be unnecessary, which would be a great advantage, especially if railways should ever be laid by the side of turnpike-roads.

If you can spare a space in the "Mechanics' Magazine" for the insertion of these suggestions,

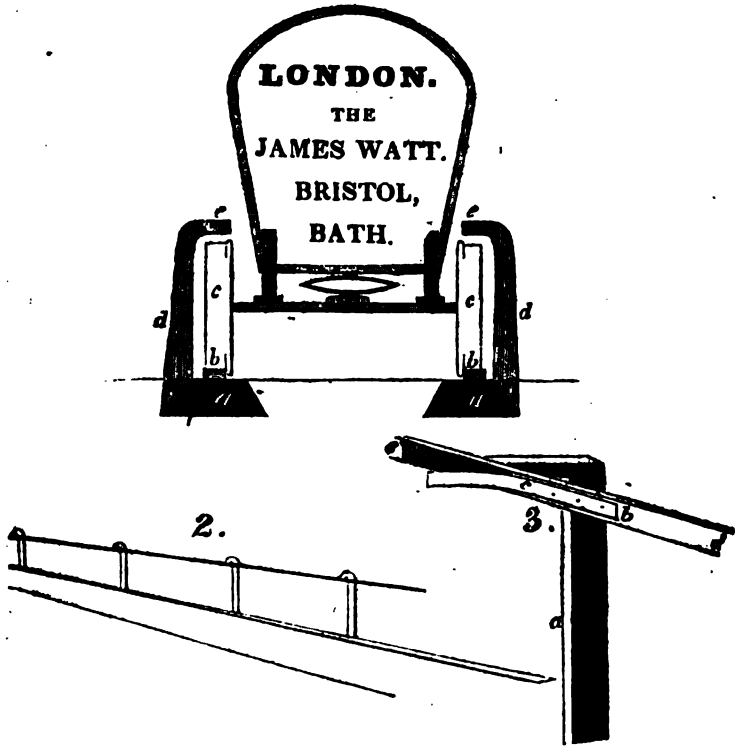
You will much oblige

Your most obedient servant,

J. MURDOCH,

Mech. Draftsman.

4, *Victoria-place, Mile-End-road*,
October 27, 1829.



SAFETY RAILWAY CARRIAGE.

Sir,—Since the result of the late decisive experiments on the Manchester and Liverpool Railway have been made known to the public, there appears to be a very general feeling that locomotive engines on railways are likely to be very speedily brought into use for the general purposes of travelling, as well as the conveyance of merchandise; and it must be confessed, that the late surprising display give us every reason to think that opinion well-founded. But it ought not to be forgotten, that there are prejudices to be removed and fears to be allayed, which, if not fairly met, may retard the attainment of what appears to be a desideratum with all men, to wit, "cheap and expeditious travelling;" and therefore it may perhaps be well if any thing can be *suggested* that will add to the security *of the railway passenger*: for we *ought to bear in mind* that the argument of the infrequency of accidents on railways, does not apply to the velocities proved to be attainable, and purposed to be used. With this view, I beg to suggest to your readers a few observations on the subject, and in explanation of the preceding figures.

I presume, in the first place, that it will be indispensably necessary to have railways securely fenced, whether they be laid on new lines or on the sides of public roads. If that be so, might not such fence or railing be so constructed as that it might check any tendency great velocities may give the carriage to fly from the rail, as well as prevent straying cattle or thoughtless pedestrians from getting into danger? Fig. 1 (a section) is intended to show this double use of a fence or railing: *a a* are the sleepers or foundation of the railway; *b b* the iron rails resting on the sleepers; *c c* the wheels of the carriage in the common form with the inner edge

ting; *d d* upright posts or rods in the sleepers, and supporting e horizontal rails of the fence, overhang and run parallel with ilway, and being distant from breadth of the wheel + some- less than the depth of its pro- g rim edge. It will be seen ie wheel being thus, as it were, in, cannot leave the rail so as the parallelism of the rail ie horizontal fence-rail is pre- ; any tendency to do so, being ed by the overhanging or hori- fence-rail on this construction. e objected that the smallness of ace between the upper part of ieel and the overhanging fence- ill cause friction, by the accu- ion of mud or snow, it may be red, that an easy remedy may l by increasing the depth of the ting edge of the wheel, and the between the upper surface of ieel and the horizontal railing; that be inconvenient, let the ntal railing *c* be placed in a n equidistant from the top of ieel and the side of the carriage, ie chances are that an overturn e prevented; but by that ar- nent the wheels will not be ited leaving the rail, as they if on the former construction. haps it might be worth while to e how far this overhanging might also protect the railway wet, and thereby diminish the of iron. I believe some minute ies were made in the neigh- od of Newcastle some years s to the destruction of iron by ling or rusting of the exposed sed in that district; but I am quainted with the results: pro- in this damp climate it will be that the exposure to rain does uch add to the unavoidable de- on of iron.—*Sed* query.

re remains to be considered the of preventing collision. I not have troubled you on this had not a little contrivance oc- to me in answering the objec- f an old gentleman a few days My friend is one of those who their information, scientific and l, from the newspapers; and *the medium of* that well-known journal, *The Times*, he has become acquainted with the Liverpool experiments, and has set his mind upon going into the country next spring at the rate of 30 miles an hour, and nothing less. But notwithstanding his desire to fly with the dove, he has serious misgivings as to the effects to be apprehended from meeting in collision the "up coach." I found it in vain to explain that the having two lines of railway would prevent such an occurrence; for while the possibility remains, so, he says, will his apprehensions. I then suggested the contrivance figured in No. 3, being simply a flat piece of iron *c* fixed on the horizontal railing *b*, and easily yielding to the passage of a carriage in the direction from *d* to *e*, but offering resistance to any passage in the opposite direction. If such springs were placed on the horizontal railing at equal distances, say a quarter or half a mile apart, they might be made to move a small clock-work attached to the carriage, which should show the distance passed over: the reading of mile-stones being, as I take it, out of the question with the new velocities. Perhaps some of your ingenious readers will suggest the plan of a railway meter.

I write these things for the consideration of those practically acquainted with the subject, which, as you may have perceived, is not the case with,

Your obedient servant,

G. WILSON.

London, Oct. 30, 1829.

REPLY BY MR. SQUIRE TO DR. BURNEY'S DEFENCE OF THE COMMON MODES OF KEEPING METEOROLOGICAL DIARIES.

Sir,—I should wish to say a few words in reply to Dr. Burney's remarks, in No. 311, on my meteorological summary in your 301st Number. Without recapitulating, I will just observe, that as the height of the Horticultural Society's barometer above high-water in the Thames at Chiswick is known, and that the goodness of the instruments and accuracy of the observations cannot be disputed; for

these reasons, I shall take the liberty of making a comparison between the barometrical observations made at Gosport and those at Chiswick.

Now, the mean altitude of the barometer at Chiswick, in 1827, was 29·950, and at Gosport 29·900, making a difference =·05; in 1828, it was at Chiswick 29·921, and at Gosport 29·868, making a difference of ·053. Hence the observations of the former year make the barometer at Gosport to be 45·422 feet above that at Chiswick, and those of the latter year 48·427 feet, giving a mean of 46·9245, or nearly 47 feet. But the Horticultural Society's barometer is stated to be 14 feet above high-water in the Thames at Chiswick, and Dr. Burney's 50 feet above low-water mark in Portsmouth harbour; therefore 46·9245+14−50=10·9245 feet. So that it appears, from these obvervations, that the low-water mark at Gosport is nearly 11 feet above high-water in the Thames at Chiswick!! Now, as we can safely depend upon every thing connected with the Chiswick observations, and that it is impossible for low-water mark at Portsmouth to be above that of high-water in the Thames at Chiswick; *ergo*, Dr. Burney's barometrical numbers must, in some way or other, be incorrect.

The Doctor says my estimate of the mean temperature in the shade at Epping is too high by about ½ of a degree; from which I judge he has taken Mr. Howard's or Mr. Daniell's result for his standard of comparison. That these gentlemen make the mean for the neighbourhood of London to be 49·5° is certain; yet as this was obtained from the daily maxima and minima, it must for that reason be too low; as it is well known that the real annual mean always exceeds this by about a degree, varying a trifle more or less in extremes.

Instead of considering 50·32° in excess for the mean temperature of the external air in the shade at this place, I have many reasons for believing that it is, on the contrary, rather in defect. According to theory, by the formula $31+53c^2$, where c denotes the cosine of the latitude, the mean temperature of Epping comes out 51·36°: spring water, and a shady part of the house which opens to the north, where the annual mean oscillates within the limits of about two degrees, give mean results but little short of that obtained by theory. But a series of careful observations made on the water in a well that is about 20 or 30 feet deep, and perfectly shaded, is the best criterion for determining the mean temperature of any place.

On this account, Dr. Burney's observations on the temperature of spring water at Gosport must be considered valuable; the mean of which for 8 years=51·884°, that of the external air in the shade for the same period =52·855°, which latter mean is certainly too high. Let us see what the above formula will give: now the latitude of Dr. Burney's observatory is 50° 47′ 20″; hence $31+53c^2=52{\cdot}182°$, which is only about $\frac{1}{10}$ of a degree greater than the mean of spring water, but is nearly $\frac{1}{10}$ less than that assigned to the air. I should consider the mean temperature for the parallel of Gosport to be extremely near 52°.

Dr. Burney is doubtless aware that good barometers, such as ought always to be used for philosophical purposes, do not require to be compared with any others for the verification of their accuracy, as they are always standard instruments of themselves. It cannot, however, be denied that many are very imperfect: such may do for the purpose of common weather-glasses, but not so if intended for scientific pursuits; these require, in every respect, the greatest care and circumspection in their construction.

The best barometers are those made by Mr. Newman, Philosophical Instrument Maker, Regent-street. This gentleman has long been convinced of the necessity of giving to this instrument every improvement that it seems capable of, both in its construction as well as adjustment; and he is well known to spare no pains for the accomplishment of these desirable ends, in which he has so happily succeeded.

I am, Sir,

Yours, &c.

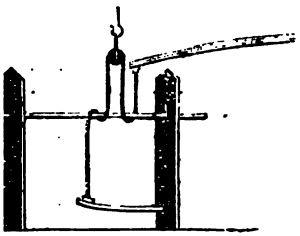
THOMAS SQUIRE.

Epping, Oct. 28, 1829.

). From the barometrical ob-
ons of 1827 and 28, Epping is
to be 323·9865, or, we may say,
et above high-water in the
s at Chiswick. But what is the
om thence to the Nore? Not
feet. Now, High-beech is a few
low Epping, yet in the trigono-
al survey, under the direction of
ard of Ordnance, this hill is
to be 790 feet above the level of
: I believe it is not more than
much. The altitudes of the
nt stations as given in this sur-
e in general very incorrect.
ell-conducted series of barome-
bservations at these and a few
ligible points on the coast, with
nents made as nearly similar as
le, and by the same artist,
be an admirable check to the
t results as given in the survey.
others, as well as my own expe-
with the barometer, I am able
n a tolerable estimate of its
where employed with proper
1 this way: it is an interesting
luable instrument when accu-
made.

T. S.

INDIAN LATHE.



Editor,—I observe in No. 309
ır Magazine a query, proposed
Young Turner at Lichfield, who
s to know how to put a string on
ng-lathe so that the work shall
continually one way. Now,
Editor, I am not a turner, nor
stand the principles of his pro-
n, and I am therefore at a loss
itable terms to express my senti-
in an intelligible manner; yet
following information should
his curiosity, I shall feel equal-
ly gratified with himself in being the means of relieving his anxiety. Here I would observe, that I think the friction caused by the string passing round the work will be so great as to render this method of but little use to him in actual business.

The foregoing figure is (from memory) of a model seen some years ago in the Oriental Museum at the East India House; and I believe the machine is used in the East Indies for twisting thread and small ropes, and may probably be used by the natives with a spring attached to it for the purpose of a turning-lathe.

The principle consists in passing the string round the work and over a beam or pulley, and then round the work again in a contrary direction to the first time; then by taking hold of one string in each hand, instead of attaching it to the lathe-spring, and moving them up and down, the work or spindle turns continually one way.

I am, Sir,
Your obedient servant,
DAN. GIDSTON.

Newport, Isle of Wight.

IBBETSON'S GEOMETRIC CHUCK.

Sir—The various applications I have had respecting the geometric chuck, combined with other circumstances, have induced me to communicate the mechanism of it to Messrs. Holtzapffel, of Charing-cross, who now construct it in its simple or more complicated character for amateurs; and to those amateurs who may purchase it, I am willing to communicate, on the principle of giving lessons, either personally or by letter, that practical information respecting the various adjustments of the different principles of my chuck, which the actual construction of it, and the long experience I have had in working it, enable me to do.

I have also communicated to Messrs. Holtzapffel my method of applying the principle of equal division of the ellipsis, as an appendage to the drilling and cutting apparatus, which acts direct on the division-plate, which is in front of the mandril-pulley. The amateur who possesses a lathe, with a

division-plate and oval chuck, will, with this addition, be able to execute every description of oval-work with the drilling and cutting apparatus, with the same facility and correctness, with respect to the equal distance of the circles or other figures, as by eccentric work is accomplished.

I am, &c. J. IBBETSON.

Smith-street, Chelsea,
Nov. 1, 1829.

A CURIOUS SUN-DIAL.

Mr. John Abram, of Canterbury, teacher of the mathematics, and author of the Kentish Tide-tables, has constructed a curious sun-dial, which is to be fixed in the front of the Droit-house, Margate, below the transparent clock. The following are the curious properties of this dial:—On the upper part is the hour-circle, to show the true solar time. Below the hour-circle is the Torrid Zone, on a large scale, with the parallels of the sun's declination (hyperbolic curves), corresponding to every half-hour of the sun's rising and setting; these half-hours are again subdivided into quarters of an hour. The time of the sun's rising and setting for the day is indicated by the extreme point of the shadow of the gnomen traversing the corresponding parallel of declination, which, by its diurnal progress over the surface of the dial, also shows, at any given instant, the true bearing of the sun by the compass, indicated by vertical straight lines, marked with different points of the compass. There are, likewise, other parallels of declination, corresponding to the entrance of the sun into each sign of the zodiac. In short, the dial points out the hour of the day, the sun's place in the ecliptic, the time of the sun's rising and setting, the length of the natural day and night, and the sun's true azimuth or bearing by the compass.

Z.

THE PHILOSOPHY OF STEAM POWER.

(From the Bull. des Sciences.)

The following laws of steam were announced by M. Morin, in a course of lectures lately delivered at Ce-

First Law.—Whatever may temperature and pressure under the steam is produced, the same tity of heat must be employed duce the same weight of steam as the quantity of heat devel proportioned to the quantity of is obvious that a given wei steam, a kilograme, for examp always cost the same price, w it be produced at a low or a pressure. This important dis is due to M. Clements, and is the finest results of his numer vestigations.

Second Law.—The volume same quantity of steam, is in i proportion to the pressure to wi is subjected. This law, discove Mariotte, is applicable to all Steam acts, in many respects permanent gas.

Third Law.—The dilatati steam is $\frac{1}{215}$ of its volume at for each degree of the centi thermometer. We are indebt this law to the remarks of Gay L and Dalton.

Fourth Law.—The latter gi elastic force of steam, according degree of heat at which it is pro The following table exhibits thi which can be expressed on numbers:—

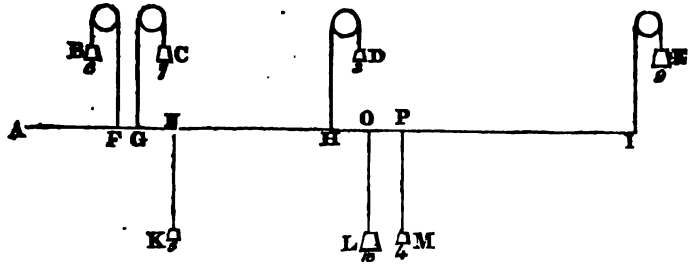
Pressure.	Centigrade.	Di
1 Atmos. . .	100° . .	
2 . .	122 . .	
3 . .	135 . .	
4 . .	145 . .	
5 . .	153 . .	
6 . .	160 . .	
7 . .	166 . .	
&c.	&c.	

NOTES ON DR. LARDNER'S LEC ON MECHANICS, AT THE L UNIVERSITY.

(Continued from page 176.)

Thirdly.—When several forc given in any parallel direction any others acting in a direction o opposite, but all parallel to each to find a single force productive same effect.

Fig. 3.



Let AI (fig. 3) represent the plane on which the following given forces, viz. B=6, C=7, D=3, and E=9, act upwards on the points F, G, H, and I, at the several distances from the end A of 5, 6, 16, and 32 inches, and let the downward forces be K=5, L=16, and M=4, acting on the points N, O, and P, at the several distances from the same point A of 8, 18, and 20 inches. Now it is evident there are still two conditions to be observed: 1st. Whether the sum of the upward be equal to that of the downward weights, (which may be found by addition,) for were the weights alone to be considered, they would be in equilibrium. 2nd. Whether the weights act in their proper places, which is to be found by the same rule as before; thus taking the upward forces.

The weight B × the distance from A=6×5=30
— C . . . . . 7×6=42
— D . . . . . 3×16=48
— E . . . . . 9×322=88—408.

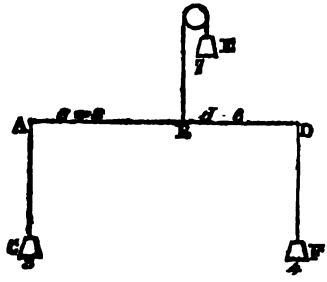
Now if the products of the downward forces be equal to the above sum, they will be in equilibrium as

The weight K × the distance from A=5×8=40
— L . . . . . 16×182=88
— M . . . . . 4×20=80—408.

And since they are in equilibrium they destroy the effects of each other, and the plane will be at rest.

There is one more case to be attended to.

Fig. 4.



Let AD (fig. 4) represent a plane, on which act the two unequal forces or weights C and E, in opposite directions, and of which E is the greater. It is required to find the place and weight of a single force that will produce equilibrium. Now from what has been previously stated, the required force will be equal to the difference of those which are given, viz. E—C. With regard to its place, it has been shown that two forces will keep a single force in equilibrium if one force bear the same proportion to the other, as the distance between the opposite weight and the single weight. Now supposing the distance between the points A and B to be expressed by the letter *e*, this proportion will stand thus —(E—C) : C :: *e* : the distance between the point B and that on which the weight (E—C) acts, and which distance may be called *d*. But if the weights C and E be known, then the other parts may be also discovered (provided the distance between them be also given). Let the weights C and

and E=7, then E—C=(7—3)=4, which will be the weight required, and let the distance e=8 inches, then the proportion will be as 4:3::8:6, which will be the value of d, and consequently be the distance from the point B, that the required weight F=4, must be to keep the other weights in equilibrium.

In the last case these given forces were unequal. Now it can be proved that the nearer they approach to equality, the further will be the distance of the required force, until they are exactly equal, when the distance will be infinite. Thus supposing the weight C to be equal to 6, then the proportion will stand thus. As E—C:C::e:d, or as (7—6)=1:6::8:48, which would be the distance of the required weight from B; but suppose the difference to be still less, viz. A=$6\frac{9}{10}$, it will be then as (7—$6\frac{9}{10}$) =$\frac{1}{10}$:$6\frac{9}{10}$::8:552, the distance required, and which will keep on decreasing until the weights are equal, when it will be as (7—7)=0:7::8:0 or infinity, when there will be no weight required, and from which this conclusion may be drawn, that if there are two equal weights acting on the same point, and in opposite but parallel directions, they will not admit of any counterpoising weight; and this may be said to be the spirit or doctrine of statical science.

(*To be continued.*)

THE SECRET OF THE COMPOSITION OF THE SCHWEINFURT BLUE.

A portion of a very fine blue pigment was placed in the hands of M. Braconnot, by M. Noel, for examination. It was the produce of a manufacture at Schweinfurt, where the preparation was kept secret. M. Braconnot readily ascertained it to be a triple compound of arsenious acid, hydrated deutoxide of copper, and acetic acid; so that it approximates to the green of Scheele. After various trials to form it, the following process was found to be the best. Six parts of sulphate of copper were dissolved in a small quantity of water; also, six parts of white arsenic, with eight parts of potash of commerce, were boiled in water, until no further quantity of carbonic acid was disengaged. This hot solution was gradually mixed with the first, continually agitating until effervescence ceased; an abundant dull yellowish green precipitate was formed. About three parts of acetic acid were then added, or such a quantity, that a slight excess was sensible to the smell; gradually the precipitate diminished in volume, and in some hours a slightly crystalline powder was deposited at the bottom of an entirely colourless solution. The fluid was poured off as soon as possible; and the powder, washed with plenty of boiling water to remove the last portions of arsenic, was then of a brilliant colour.

Care must be taken not to add to the cupreous solution an excess of arseniate of potash, as it causes waste of the acetic acid afterwards added, as the latter must be in excess. In repeating the process in the large way, an arseniate of potash, prepared with eight parts of oxide of arsenic, instead of six, was used, and the result was very successful. M. Braconnot thinks that probably a slight variation of the proportions he has given may be found advantageous; but in the mean time he considers it right to give the best process he is able for the preparation of a colour so beautiful, and which may be very valuable in the arts.

CHINESE SUBSTITUTE FOR CANAL-LOCKS.

(*From the Boston Journal of Science.*)

It has been observed, that locks were unknown to the ancients; they are still unknown to the Chinese. Some of the canals of China, however, are constructed on different levels, and their method of passing boats from one level to another is worthy of attention. The levels are connected by inclined planes, constructed of hewn stone; these inclined planes, in some instances, connect levels differing 15 feet in elevation. In passing from the upper to the lower canal, the boat is raised out of the water, and launched over the inclined plane; the last part of the operation, of course, requiring no great labour, as the friction over the plane retards the descent of

: but in passing from the in- the superior canal, powerful are required. These consist tans, from which ropes are ound the stern of the boat. rt of a hundred men is some- quired to effect the elevation ded boat. The objection to de, taken in this simple and n, lies not only in the great equired by it, but in the injury must necessarily be done to s. The practice could never ted with the slightly-timbered sed in our canals, which are ed to be supported by the fluid they move, and which presses orce perfectly equal on every th which it is in contact. re some situations, however, from a scarcity of water, the plane is necessarily substi- r the lock. Some works of d are used on the Continent pe; and in England, in some ere the weight of the descend- tly exceeds that of the ascend- modities—as in the traffic be- nines and furnaces—inclined re used with advantage. In tuations, the descending and boat is made to drag up an ag one, which is empty, or but loaded; thus exhausting in a purpose a force which not pended in friction, as rollers ls are used between the boat plane, could not be otherwise ed without some labour and

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NOR CORRESPONDENCE.

s Patent Studded Shoes.—Sir, My mas- akes in your valuable Magazine, hav- ne what he had read in it about Jack- nt Studded Shoes, I bought a pair of wards of two months ago, which I ever since in my humble occupation layer's labourer, and find them as yet he worse for wear. On telling my w much I was obliged to him for the n, he said the least I could do was to , from whom he had it; and this, as in d, I now do. I generally wore out a iled shoes in about three months, but e studded shoes will last me twice as was rather afraid the studs would rounds of the ladder, as the common a do when they are sometimes drawn I do not find this to be the case with

Sir, your obliged servant,
P. O. B.

ilway System.—Sir, In the *Morning* of the 1st of last month there is the paragraph respecting the Ohio Rail- way: "The entire line of the railway is in steady progress to completion, with as much order as any undertaking of similar magnitude can be conducted." Ohio is, as your readers are aware, one of the *back states;* and as rail- ways are already laid down *throughout* the United States, your readers have to complain *not* that you are arousing the public to this sub- ject, but that the United States have taken the lead. Your correspondent "B" will perceive that you are labouring to prevent the United States from wresting from us our commercial and (I may add) maritime superiority, and that Liverpool and Manchester are but acting in *self-defence.*

I am, Sir, your obliged servant,
Nov. 2. T.

Railways.—Mr. Editor, With respect to the proposition of "W. B." in your Magazine of Oct. 24, 1829, No. 324, relative to the putting "rollers" in the place of the surfaces that the locomotive carriages now go on, I should like to offer you some particulars in furtherance of his scheme, but that would be useless, until *it is ascertained by what contrivance* those rollers are to be put in motion. "W. B." seems to have overlooked that the motion of the machine is dependent on the wheels of it, impelled by the power of the materials within it; and that deprived of its own wheels, and their mover—steam—the machine must *stand still.* However, where *horses are used,* I think his scheme worthy a thought, and that all difficulties would be re- moved. I should be glad to see this noticed by some competent practitioner of experience in your Magazine. I am, Sir, yours, &c.
C. H.

Sir, Although I take a lively interest in rail- ways and railway carriages, and am by no means of the opinion of your correspondent "B," yet I do not see how the wheels in any of the carriages are propelled; and if you will be so good as explain how the wheels of "The Novelty" are put in motion, you will greatly oblige, A YOUNG READER.

[If our "Young Reader" will study a little more attentively the engraving on our 130th page, and imagine to himself what will be the effect on the bell-crank E, and connecting rod D, of alternately moving upwards and down- wards the sling F, he can scarcely miss perceiv- ing that that effect must be to turn the wheels continually round. This is commonly known by the name of the simple crank movement, and was first devised by Watt.—EDIT.]

Sir, Some time back I invented a pendulum, which oscillates in a cycloid. I believe rewards have been offered for a pendulum of this de- scription, because some great advantage would accrue to the astronomer, from the equable mo- tion which mathematicians say must result from its describing a cycloid. Any gentleman informing me what the rewards are, by whom they are offered, and how they may be obtained, would confer a benefit where it is needed.

INDIGENS.

[We are not aware that any reward has been specifically offered for such a pendulum as our Correspondent states he has invented; but it being one of the peculiarities of the cycloidal curve, that a pendulum wheel oscillating in it must perform all its vibrations in equal spaces of time, such a pendulum would supply so ob- vious a desideratum, in the measurement of time and determination of the longitude, that the inventor could scarcely fail to reap an ample reward by the disclosure of his invention.—We take it for granted that our Correspondent is aware of the cycloidal pendulums invented by Huygens and De la Hire, and that his inven- tion is something more perfect than either. EDIT.]

Sir, I have read a great deal in your Magazine about perpetual motion, and have studied this disheartening question many years before your work began. In No. 319, I see there is an account of a perpetual motion invented by one Richard Von Dyke, of America. I do not suppose any one can understand what that machine is from such an account; but no doubt it was the best you was able to procure. I verily believe that I invented the same thing a few months ago, but was prevented from putting it to the test of experiment by great troubles in my family. The doctors and the undertakers had taken away all my fiddling money; otherwise, I should have tried the thing before this time. If a few of your Correspondents will favour me with their addresses, I will appoint a time and place to have their united opinions on my scheme. But I hope no one will apply to be of the number who does not know something about pneumatics: I do wish that person to be one who wrote on the subject, p. 399. No. 312. I remain, Sir, your humble servant,

R. W. FRANKLIN.

North-place, Wilstead-street, Somers'-town.

P.S. When the gentlemen have examined my drawings, I wish some one of them to give your readers an account of it.

MISCELLANEOUS.

A Capital Filter for Four-pence!—Buy a common earthenware funnel, put a small piece of clean sponge at the top of the pipe inside, and over that a handful of fine gravel; then fill it up with water, and, after passing through, it will come out as clear as crystal. Thus you have quite as good a filterer for domestic purposes for four-pence, as can be purchased for As many pounds.

Musical Automata.—A mechanician, brother to the celebrated Maelzel, of Vienna, has constructed at Boston a set of musical automata, no less than forty-two in number, which compose a complete orchestra, and execute several of the most difficult pieces of music in the most perfect manner,—among others, the Overtures to Don Juan, Giovanni, Iphigenia, and La Vestale. Those which excite the most admiration and wonder are the violin-players, which execute their portion of the music precisely as if they were living performers, viz. by the motion of the fingers, &c. A company of Americans have offered the artist 300,000 dollars for this extraordinary and unrivalled piece of mechanism; but the price demanded is 500,000 dollars, and it seems probable that it will be obtained.

King's College.—The piles are now driving into the ground for the foundation of the King's College. From the proximity of the building to the bed of the river, and the nature of the soil, this is a work of great labour, and requires infinite care.—*Sunday Times.*

News for the Needle-Makers.—An Englishman writing from France says, "The needle and pin manufactories around Aix-la-Chapelle are half a century behind England in the qualities of the articles, and a case of real English needles is a most acceptable present to a Belgian lady. —*Morning Herald.*

Discovery of Coal in Van Dieman's Land.—A very fine vein of coal has been discovered in Van Dieman's Land, upon which a survey has been held, and some experiments tried, in order to determine its fitness for use on board of steam-vessels, which, it appears, have been fully satisfactory.—*Sunday Times.*

Preservation of Apples.—It is the practice of some persons to pick apples in October, and spread them on the floor of an upper room. The practice is said to render apples more durable *by drying them*; but I can affirm this to be a *mistake*. *Apples*, after remaining as long on the trees as safety from frost will permit, should be taken directly from the trees to close casks, and kept as dry and as cool as possible. If suffered to be on the floor for weeks, they will wither and lose their flavour, without acquiring any additional durability. The best mode of preserving apples for spring use I have found to be the putting them in dry sand, and as soon as picked. For this purpose I dry sand in the heat of the summer, and late in October put down the apples in layers, with a covering of sand upon each layer. The advantages of this mode of treatment are these: the sand keeps the apple from the air, which is essential to their preservation; the sand checks the evaporation of the apple, thus preserving their full flavour, at the same time any moisture yielded by the apple, and some there will be, is absorbed by the sand, so that the apples are kept dry, and all mustiness is prevented. My pippins in May and in June are as fresh as when first picked; even the ends of the stem look as if just separated from the twig.—*Massachusett's Agricultural Rep.*

Discovery of Pure Gold.—A beautiful specimen of virgin gold was lately found in a tin-stream in Cornwall. It is about the length and thickness of a lady's little finger, though less regularly formed, and weighs about two ounces. Its intrinsic value is equal to nine guineas, but, as a specimen, it is invaluable.

New Paper.—The Mexican congress has passed an act, enjoining the different departments of the Mexican government to use no other paper than that which is made from a vegetable grown in Mexico called *magney*. Manufactories of paper from this plant have been established at Queretara and St. Angel; and the paper is said to be equal for all purposes to that made from the finest rags.—*Literary Gazette.*

INTERIM NOTICES.

In our next we shall give an engraving and description of the steam-engine carriage of Sir James Anderson and Co.

Erratum.—In the statement given in our last No. (p. 165) of the cost of the fuel per mile expended by "The Novelty," for "one farthing" read "one halfpenny." Mr. D. of Newcastle-on-Tyne, who makes this error the ground of a serious charge against us, observes, that it is one which "any child who knows arithmetic" might easily detect. We agree that it is so—an error so palpable that no person, man or child, could be misled by it; but we think our Correspondent might have seen in this very circumstance reason enough to infer that it could not possibly have been *intentional* on our part. It was, in truth, an error of the press entirely; arising from the "one halfpenny" being expressed in the original MS in figures (½), and that rather indistinctly. We have elsewhere, in the same page, stated most explicitly that "The Novelty" worked with only "*two-thirds* less fuel than any other engine." At a farthing per mile the rate would have been five-sixths less.

Messrs. Cope and Sherwin's reply to Mr. Hopkinson in our next.

Communications received from F. F. O. B., Δ, Mr. Dowling, P. P., Peter, R. C. jun., Mr. Davy, T. F. R., and A Reader at Liverpool.

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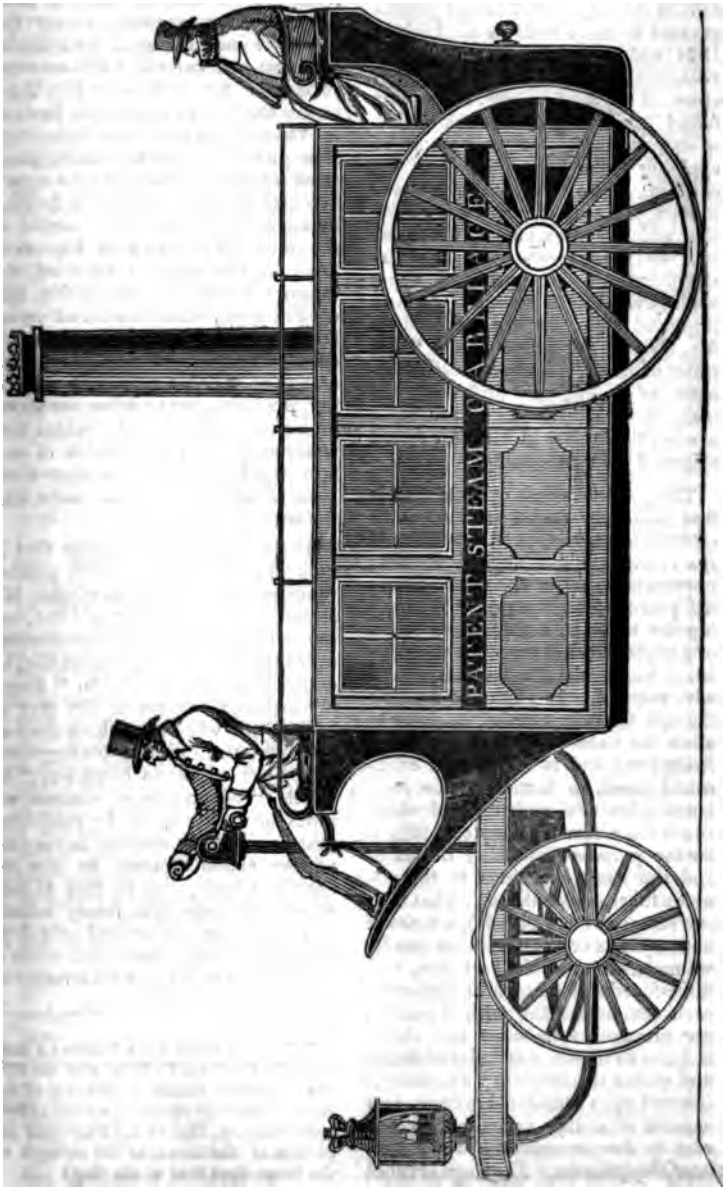
M. SALMON, Printer, Fleet-street.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 327.] SATURDAY, NOVEMBER 14, 1829. [Price 3d.

PATENT STEAM-CARRIAGE OF SIR JAMES ANDERSON, BART., AND W. H. JAMES, ESQ.



PATENT STEAM-CARRIAGE OF SIR JAMES C. ANDERSON, BART., AND W. H. JAMES, ESQ.

The leading principles of construction embodied in this steam-carriage formed the subject of different patents granted to Mr. James as far back as 1824 and 1825; but, like other adventurers in this new field of mechanical speculation, Mr. James has found it necessary to alter and modify so extensively his original modes of applying these principles, that his carriage, as we now present it to our readers, is a very different thing from that which figures among the drawings at the Patent-Office. For the engraving on the preceding page, which exhibits this engine in its most improved state, we are indebted to Mr. Hebert, the Editor of the "Register of Arts;" of whose able assistance, as an engineer and draughtsman, the patentees have prudently availed themselves in the more recent stages of their undertaking.

The point to which our attention is first naturally called in this, as in other new engines, is the manner of *generating the steam*. Mr. James's improvement in this respect consists, as his patent of 1825 states, "in forming the boiler by combining a series of annular tubes or ring-formed chambers; which chambers communicate with each other by apertures running through the whole series, in order to allow the water and the steam to flow freely from end to end of the cylindrical vessel, so formed by the combined tubes or chambers; and which vessel has a furnace adapted within it for the purpose of heating the water and the steam contained in the annular tubes or chambers." That is to say (to speak more plainly), a series of hollow rings or annular tubes (made, we understand, of the best iron, and three-fourths of an inch in diameter), each communicating with the other, are arranged spiral-wise and circularly, so as to form a cylinder of rings; and within this cylinder "a furnace is inserted upon suitable bearings, and capable of sliding in and out, which with its flue occupies the whole interior *of the cylinder*." The rings or tubes of an 8-horse* engine, such as that represented on our front page, form a continuous length of 430 feet 5 inches. They are filled with water rather more than half way up. The "flame and heated vapour arising from the furnace, in passing from thence to the chimney, enters the jacket (or outer casing of the cylinder of rings), and embraces the external surface of the tubes."—"By these means the water in the lower parts of the vessel (lower portion of the tubing) is made to boil, and the steam generated therefrom rising into the upper, becomes greatly increased in its elastic force by the immediate action of the fire." The steam is kept confined in this upper portion of the tubing till the pressure reaches any desired point, when it is let off by an eduction-pipe into the working cylinders. The pressure required in the engine of which we give an engraving, is 200lbs., but its tubes are stated to have been proved by steam and water pressure to be capable of sustaining a force of 4000lbs. upon every inch, which is twenty times more than the strength requisite.

The working cylinders are four in number; and herein consists another peculiar feature of this carriage. Mr. James, in his first patent of 1824, cast somewhat of an air of mystification over this branch of his invention, by describing it as consisting in "adapting separate engines to the gear of each of the wheels on which the carriage runs, instead of actuating them all by one engine as heretofore;" by which "adaptation of distinct engines to each wheel," he considered that he should be enabled to vary the powers communicated to the respective wheels, and to give to each wheel an independent rotary motion, so as to cause the several wheels to turn with different velocities, which is essential to moving the carriages in

* Must not this soon become a most inapplicable term? How can we with any propriety continue talking of the horse-powers of engines, which exhibit performances, that as far transcend the powers of the horse, as the strength of the horse does that of the dog?

curves or turning corners, &c. These "separate engines" turn out, in fact, to be only separate cylinders, one for each wheel. Mr. Hebert says, that since they "act together, or *separately*, upon cranks at right angles, *they may be therefore justly regarded as four complete steam-engines*;" and as if this were so clear that there could be no doubt about it, he afterwards tells us, "the compactness and simplicity to which the steam-engine has been reduced in this carriage is so extraordinary," that he "would undertake to put one in each of his coat-pockets!!!" Now, to call each separate cylinder a separate engine because the cylinders can "act together or separately," is just about as proper as it would be to call each leg of a horse a horse, since they also can act together or separately. There are many other things which are as essentially component parts of a steam-engine as the cylinder; and unless Mr. Hebert be emulous of the fame of a Munchausen, or a Fernandez da Pinto, when next he talks of putting a whole engine into his pocket, he ought to add *all but*—the furnace, the flue, the chimney, the boiler, the casings, the pumps, the frame-work, &c.

The steam, according to the mode set forth in Mr. James's patent, was to be passed from the boiler through a pipe extending along the perch of the carriage, and thence through lateral pipes to the four working cylinders. Stop-cocks, or slide-valves, were to be introduced at the points of junction between the long steam-pipe and the lateral pipes: by the turning of which cocks it was calculated that a greater or a less supply of steam would be transmitted to their respective cylinders, the pistons would be made to work faster or slower, the wheels would be caused to revolve with different velocities, and the carriage consequently to run in a curved or circuitous direction. "By this contrivance" to use the words of the patentee, "the guiding of the carriage will be effected by the turning of the stop-cocks, as when a greater supply of steam is allowed to pass into one engine than into the other, that engine will necessarily work faster, and drive the wheel connected with it over a greater surface of ground; while the engine at the opposite end of the axletree, being supplied with a diminished quantity of steam through the contracted aperture of the cock, will necessarily move slower, and drive the wheel over a lesser distance of ground."

It would seem, however, from the last notice of this steam-carriage by Mr. Hebert ("Register" for November last), that this arrangement for the distribution of the steam has undergone considerable modifications. The four working cylinders are represented as all situated "*between the hind-wheels*;" whence it may be inferred that it has been found sufficient to transfer the action of the pistons to the hind-wheels alone, leaving the fore-wheels to derive their motion from the general impetus given to the carriage. The steam-pipe along the perch and its branch-pipes are of course now dispensed with; but the government by stop-cocks will remain as before. Mr. Hebert describes it as being so efficient, that the carriage can be made to describe "every variety of curve;" he has even seen it "repeatedly make turns of less than 10 feet radius."

The manner in which the driver, or, more properly speaking, steersman of the carriage, exerts a control over these stop-cocks, is thus described in Mr. James's specification:—"Suppose the axles to stand at right angles to the perch, the carriage would necessarily advance in a straight-forward direction; but in order to guide the carriage round a corner or curved part of the road, the director seated in front must turn the vertical shaft (by means of the cross-bar on which he rests his hands), which will cause* the axletree of the fore-wheels to stand at an oblique angle to the perch; when the stop-cock, communicating between the main steam-pipe and the lateral pipes, will open the aperture wide on one side and contract it on the other, thereby giving an increased power to the engine connected with the outer

* By means of a toothed sector, in which this shaft terminates, and which sector works into a toothed circular rim under, and connected with the fore-axles afterwards mentioned.—Rep. M. M.

wheel, so as to make that wheel revolve faster, and a diminished power to the engine connected to the inner wheel, so as to cause that wheel to revolve slower. In order to act in a similar manner upon the hinder-wheels, there are rods which extend from a lever upon the square of the hinder stop-cock; and these being attached at their reverse ends to a toothed sector, taking into a toothed circular rim affixed to the fore-axle; whenever that axle stands at an oblique angle to the perch, the aperture of the stop-cocks will admit different quantities of steam into the two lateral pipes; and consequently the two hinder-wheels will also revolve with different velocities, and thereby conduct the carriage in a curved track."

But this branch of Mr. James's arrangement appears, from our prefixed engraving, to have been also greatly altered. None of the rods which command the stop-cocks, have now apparently any connexion with the fore-axle; and the circular rim and toothed sectors which work into it are placed above the fore-axle immediately under the foot-board of the steersman. It is evidently sufficient that each sector should have two of the rods connected with it, one at each extremity of the segment, in order to give the steersman all the command he wants; and we have little doubt this is the plan which is at present adopted. The mode of working will be precisely similar to that which most of our readers must have seen followed in the steering of boats; the horizontal rods which command the stop-cocks in the rear of our steam charioteer, serving the same purpose as the yoke lines in the hands of a coxswain.

The four cylinders are placed horizontally between the hind-wheels, and they are stated by Mr. Hebert to occupy a space of only one foot in breadth by two feet in height! The length is not given. The smallness of the dimensions may well be termed "extraordinary." Each cylinder cannot at this rate be more than two inches in diameter! The cylinders in Mr. Gurney's and Messrs. Braithwaite and Ericsson's engines are six inches in diameter.

The steam is worked expansively, and at a pressure of 200lbs.; the pistons are said to perform from 200 to 400 strokes per minute.*

The mode in which the action of the pistons is transferred to the wheels is not exhibited in our engraving; but may be gathered from the terms of Mr. James's specification. "The wheels on which the carriage runs," says the patentee, "move loosely upon their axles as usual, but have attached to their naves on the inner side toothed wheels. Similar toothed wheels are affixed to the outer extremities of the crank shafts, which are actuated by the alternation of the piston rods. The teeth of the one set of wheels take into the teeth of the other set; and thus by the revolution of the crank shafts, a rotary motion is given to the wheels in which the carriage runs."

When it is required to stop the carriage, this is done by completely shutting off the steam, and closing the exit passages. "For this purpose a rod is placed in front near the seat of the conductor, who, by raising the handle, moves two cranks beneath, which are connected with rods (extending under the carriage) that command the cock which admits the steam from the boiler into the general eduction pipe, and also the cock which allows the steam, after quitting the cylinders, to escape into the chimneys."

The great hindrance to the use of tubular boilers, like this of Mr. James's, has hitherto been that the water deposits earthy matter, which adheres to and encrusts the interior of the tubes;

* Mr. Hebert says, "the speed of the engines varies from 200 to 400 strokes;" but he must necessarily mean that the work of the four pistons, taken together, amounts to this. As Mr. Hebert can have no wish to mislead the public so widely on the subject as this statement is calculated to do, it is a pity he should make use of language so capable of misconstruction. Persons who have read that "The Novelty" performed only 140 strokes a minute when going at the rate of 22 miles, would be naturally led to infer that an engine which performs 400 strokes a minute must be one of three times the power.

and where the tubes are of small diameter, speedily chokes them up. The following is Mr. James's remedy for this evil: "It is proposed to place at the bottom part of each chamber a few shots, marbles, or other loose articles, in order to clean the interior of the boiler by friction; and to assist this object, it is contrived that the boiler shall be capable of revolving or vibrating. When it is wished to clean the boiler, the furnace must be withdrawn, and the steam and water pipes unscrewed; then (having nearly filled the chamber with the water) by manual labour applied to the handles the boiler must be caused to revolve, or to vibrate to and fro upon its axle and guide rollers, when, by the friction of the shots above described, the incrustation or sediment will be broken up, and discharged with the water employed in washing it." We hope Mr. James may find these expedients to answer his expectations; but we must confess we have but an indifferent opinion of their efficacy. The incrustations which will take place in tubes of three quarters of an inch in diameter, under a temperature of many hundred degrees, will indurate so quickly, that unless he repeats his *hurdy-gurdy* process every twenty-four hours at least, we suspect he will find himself at last literally *playing at marbles*.

The total weight of the steam-carriage, including fuel sufficient for 50 miles, and water for about 20 miles, is stated by Mr. Hebert not to exceed 26 cwt.; a weight considerably less than has yet been realised in any engine of equal powers.

What these powers are, indeed, has not yet been very satisfactorily verified. Such as the evidence is, however, upon the subject, we shall lay it before our readers.

Mr. Hebert states, (Register of Arts for Nov.) that the experiments of Sir J. C. Anderson and Mr. James have been "chiefly made within their own premises, round a circle of 160 feet in diameter;" but that in "some trips recently made on the Croydon road, the speed of the carriage averaged full twelve miles per hour."—"Although arrangements," he adds, "*have been made for increasing* the speed to more than 20 or more miles, it is not the wish of the proprietors to go beyond 12, considering that velocity to be as great as is consistent with personal safety on the thronged public roads." It would be an easy matter," he further insists, "to run 20 or 30 miles per hour on the common road, or even 100 miles per hour on a good railway, by the introduction of a blast to the fuel: a blowing machinery is, however, not only unnecessary, but very injurious in its effects upon the metal of which the boiler is composed."

The testimony of Mr. Culbard on the subject, we noticed briefly in a former Number (324); we now give his statement at length:

"A series of interesting experiments were made throughout the whole of yesterday, with a new steam-carriage, belonging to Sir James Anderson, Bart., and W. H. James, Esq., on the Vauxhall, Kennington, and Clapham roads, with the view of ascertaining the practical advantages of some perfectly novel apparatus attached to the engines; the results of which were so satisfactory, that the proprietors intend immediately establishing several stage coaches on the principle. The undersigned was favoured with a ride during the last experiment, about six o'clock in the evening, when the machine proceeded from Vauxhall Bridge to the Swan at Clapham, a distance of two and a half miles, in about ten minutes (which is at the extraordinary rate * of fifteen miles an hour) notwithstanding only about a fourth part of the steam generated by the boilers entered the working cylinders, owing to the unsoundness of some joints in the induction pipe, which was made in a very slight manner, merely to serve out the experiments. From what I had the pleasure of witnessing, I am confident that this carriage is far superior to every other locomotive carriage hitherto brought before the public, and

* "It is necessary to explain to the unscientific reader, that this is an extraordinary rate on the common road, on which the friction or resistance to the motion of a carriage is ten* times more than on a good iron railway; and that had this carriage been on the Manchester and Liverpool Rail-road, it would have gone three or four times faster than the fastest of the vehicles tried thereon a few days ago."

* Only seven.—Ed. M. M.

that she will easily perform fifteen miles an hour throughout a long journey, notwithstanding large bets have been laid, that she will not perform a journey to Brighton in six hours. The total weight of the carriage, including water and fuel, is under one ton. The body of the carriage, if not elegant, is neat, being of the figure of a parallelogram. It is a very small and compact machine, and runs upon four wheels.

"WILLIAM CULBARD.

"138, *St. John-street, West Smithfield.*"

Separating the matter of fact contained in these statements from what is matter of assertion or faith merely, it amounts to this, that the carriage has gone "some trips," of what length is not stated, at the average rate of 12 miles per hour, and one trip of 2½ miles in ten minutes, that is at the rate of 15 miles per hour. Now there is nothing in these performances which we cannot readily suppose this carriage to be capable of performing, without its following inferentially that it can go at the rate of either 12 or 15 miles for a long continuance, or even for an hour at once, as "The Novelty," and "Rocket," and "Sans Pareil," all did, at the late competition. A man may muster strength enough to run a mile in ten minutes, who could not run four miles in ten times ten minutes; and, so we fancy, may a steam charioteer.

But though these performances do not warrant the flattering conclusions which Messrs. Hebert and Culbard have drawn from them, it is equally true that they furnish no ground on which to anticipate any thing unfavourable of the engine. All that can be fairly said is—it has yet to be shown, that it can go for sixty minutes or longer at as good a rate as it has gone for ten: let it do that, and let the exhibition be in the broad daylight, in the presence of thousands, and the patentees will have no need of inflated panegyrics, or Smithfield certificates, to spread their fame. It must be the sincere wish of every person interested in the success of steam-travelling, that Mr. James *should* succeed to the utmost extent of his anticipations; *for though* it is quite true *there is no danger in large steam-chambers which* cannot be effectually guarded against by safety-valves, yet if an entirely tubular boiler, such as that of Mr. James's, could be made to answer in practice, we should have absolute security from danger substituted for (at least) a possible risk, and prejudices and fears would be at once obviated, which, as matters are, it may take a long time to remove.

Mr. Hebert states, that "although arrangements have been made for increasing the speed to twenty or more miles, it is not the wish of the proprietors to go beyond twelve, considering that velocity to be as great as is consistent with personal safety on the thronged public roads." Is it not strange that the proprietors should be making "arrangements" to do that which they nevertheless do "not wish" to do, and which they are afraid will not be "consistent with personal safety?" But what "arrangements?" Mr. Hebert talks as vaguely on the subject as if he were getting up a conjuration for the wonderment of a Melksham mob. He must know that there is no man of science who can be deceived by such language, and that the only conclusion to which it is likely to lead even persons of the commonest understanding is, that *the wish* of the proprietors is precisely as their *power*.

"It would be an easy matter," Mr. Hebert adds, "to run 20 or 30 miles per hour on the common road, or even 100 miles per hour on a good railway, *by the introduction of a blast to the fuel*." According to Mr. Culbard, it would have been an easy matter for this engine to go 100 miles and more on a railway, *without* the introduction of any blast. "It would have gone three or four times *faster* than the *fastest* of the vehicles tried" on the Liverpool and Manchester Railway. We must presume that Mr. Hebert knows best how the fact stands, and that in truth "the introduction of a blast" is necessary to enable this carriage to travel at such great speeds.

We were about to apply this admission of what may be effected through the agency of a blast, to enforce the excellence of the plan on which "The Novelty" of Messrs. Braithwaite and Ericsson is built; but on proceeding with our perusal of

Mr. Hebert's remarks, we find to our surprise, that though he has just said that a blast is necessary to obtain a speed of 20 or 30 miles per hour on a common road, or 100 on a railway, he adds in the next breath, "a blowing-machine is, however, not only *unnecessary*, but very injurious in its effects upon the metal of which the boiler is composed." We are really at a loss to know what to make of such saying and unsaying. Will Mr. Hebert have the goodness to tell us what it is he really means? To explain how he considers the introduction of a blast to be both necessary and unnecessary to obtain these great rates of speed? To inform us, whether he can by any other expedient than by the use of a blast, accomplish the feats of which he speaks? If we might presume to translate Mr. Hebert's sayings into consistent language, the translation would stand thus:—"It would be an easy matter with the aid of a blast to run 20 or 30 miles per hour on the common road, or even 100 miles per hour on a good railway; but a blowing-machine is unnecessary to obtain that rate of speed to which Sir J. C. Anderson and Co. wish to limit themselves, as the only one consistent with personal safety, namely, twelve miles per hour; and it is besides objectionable on account of its injurious effects on the metal of which the boiler is composed."

But though this would be consistent language, it would still be very deficient in correctness. That "it would be an easy matter" for "The Novelty," or an engine on the same principle, to go 20 or 30 miles on a common road, or 100 on a railway, we make no doubt; but if Mr. Hebert really means to affirm (as his words imply he does) that it would be an easy matter "for the *carriage of Sir James Anderson and Co.* to do so "by the introduction of a blast," we have no hesitation in meeting his assertion with a positive denial. The engine of this carriage is so constructed, that a blast could not possibly be applied except to destroy it. The tubes being all exposed to the direct action of the fire, and one-half of them only filled with water, the *same effect would be* immediately produced as was produced in the case of "The Novelty," when, through a deficiency in the supply of water, one of its tubes was left bare—the tubes would be burnt through, and the steam and water rush in upon the fire and extinguish it.

That a blowing-machine must in *all* cases have effects so "very injurious" on the metals exposed to its influence, as to counterbalance the immense advantages which it is admitted on all hands can be gained by it, is not a conclusion of that sort which the public will be disposed to adopt on the mere assertion of any individual, however respectable. Every one must at once perceive that there is an essential difference between the case of tubes exposed, as in Sir James Anderson and Co.'s engine, to the direct action of fire and flame, and that of tubes immersed in water, and subjected to the influence of hot air only, according to Messrs. Braithwaite and Ericsson's plan. "The Novelty" has not, as yet, been worked long enough to justify us in referring to that engine for any proof of the innocuousness of a blast when so applied; but there are other engines on the same principle which may be referred to, the performances of which might shake even the incredulity of Mr. Hebert on the subject. We have seen one at Mr. Braithwaite's factory, which has been in constant work for about ten months, under a pressure of from 40 to 50lbs. per inch, the steam-chamber of which is of the same size as that of "The Novelty," and the tubes only one-sixteenth of an inch in thickness; and it appears now as whole and sound, and in as good a working state, as ever.

BRAITHWAITE AND ERICSSON'S STEAM-ENGINE BOILER.

Sir,—It appears by your last number that Mr. Braithwaite, true to the name and calling of his Saxon ancestors, who were *Brathe-wihts* (which means, in our refined language, Blowers-up), has been attempting to blow *me* up—not (thank Heaven!) with his "great steam-chamber A," for that is an awful SEPERATORY indeed, but with a goose-quill! The explosion of such

small tubes I however regard with no more apprehension than the boy's firework called a *cracker*, which has, by the bye, been most aptly compared by the editor of "The London Journal of Arts" to Mr. James's patent boiler: for, were it possible to burst by the pressure of steam any of the tubes in that boiler, the effect would be as harmless as that produced by the explosion of the distinct portions of the *cracker*; but taking collectively the steam in all the tubes of the former, and all the powder in the envelopes of the latter, their explosion would then be dangerous. It is, however, useless labour to attempt to show by reasoning, what every reader of "The Mechanics' Magazine" fully understands; namely, that the comparative safety of steam-magazines is in proportion to their diminished capacity, all other circumstances relating to them being the same. Indeed, it is clear that Mr. Braithwaite is of the same opinion himself, however angry it makes him that other people should think so too. Alluding to me, he says, "*the great steam-chamber A is with him a source of prodigious alarm, although such chambers are common to* ALL *high-pressure engines, as well as 'The Novelty;' and the one in 'The Novelty' is one of the* SMALLEST *ever known, being at least three-fourths less than the steam-chambers of 'The Rocket' and 'Sans Pareil.'*"

As to the construction of "The Rocket," I was not previously acquainted with it; but it appears now, from the statement of Mr. Braithwaite, to be of the *Congreve kind*: and with respect to "The Sans Pareil," it is devoutly to be hoped that it will ever retain a right to its present proud title. From the preceding extract, it is evident that Mr. Braithwaite takes credit to himself for having a *smaller* steam-chamber in "The Novelty" than is possessed by "*The Rocket*," or "*The Sans Pareil*;" he goes further, and observes, that his steam-chamber is the SMALLEST ever known, meaning of course that it is so much better, or safer, for that reason. Now the gentleman who makes this assertion, knows very well that the steam-chambers in James's boiler are only *about a five-hundredth* part of the area, for he endeavours to throw ridicule upon them from that very circumstance; and notwithstanding, they are in consequence, according to his own argument, 500 times better and safer than his own. All this inconsistency proceeds from a person who charges me with "misrepresentation"—"gross perversion of the truth"—"illiberal aspersions"—"interested motives"—"palpable subserviency"—"egregious misrepresentation," &c. &c. without, however, condescending to prove one of them; and for no other reason that I can discover, than his predilection for *blowing-up*.

Considering how he would himself act under similar circumstances, Mr. Braithwaite accuses me of interested motives, because, forsooth, I had been engaged (as I mentioned myself) in making drawings for Messrs. Anderson and James; but it unfortunately happens for that sagacious conclusion, that I have a direct pecuniary interest in the locomotive carriage of a rival concern. This does not, however, prevent me from repeating, that Mr. James's boiler is the only one I have hitherto seen that is adapted to locomotion by steam power, whether in carriages or boats, on account of its PERFECT SAFETY, there being no magazines of steam which are more than about an inch in diameter; and from repeating my opinion, that Messrs. Braithwaite and Ericsson's is, on the contrary, as DANGEROUS as any that have hitherto fallen under my observation. I have not given those opinions unaccompanied by reasons for them; and no man in his senses can say that I have mis-stated facts to the prejudice of Mr. Braithwaite, as I have given the account of those facts, word for word, from "The Mechanics' Magazine," which Mr. Braithwaite states is the only correct account.

I have said that the *boiler* gave way, which Mr. Braithwaite calls a "gross perversion of the truth," and asserts that there was no giving way of the *boiler* at all in the case of "The Novelty," but a *yielding* of part of the *furnace-flue*, in consequence of its being "ACCIDENTALLY EXPOSED TO A DRY HEAT OF HIGH TEMPERATURE." Now, suppose Mr. Braithwaite, having the propensity of his forefathers full

im, were to march straight into
:hen, and commence to *blow-up*
fire, on which was placed a
with very little water in it; the
being quickly evaporated, and
tle exposed to a "dry heat of
emperature," the metal would
o the blast, and a hole would
e made through the bottom or
on perceiving which, Betty
naturally exclaim, "Lord, sir,
ive blown a hole through my
" Would Mr. Braithwaite then
her, "Slut, you are guilty of
perversion of the truth, and
terested motives for saying so;
as no *giving way* of the kettle
but merely a *yielding* of part of
nace-flue, in consequence of its
accidentally exposed to a dry
f high temperature!" Poor
astounded, would probably
with the "most noble Festus,"
y, if she durst, "Much learn-
th make thee mad."
my part, Mr. Editor, I see no
nce between the two cases; in
lers the water is on one side of
tal of which they are formed,
e furnace or furnace-flue on
her. Had you not favoured
eaders with a section of "The
y's" boiler, it might have been
ted that the *yielding* was in part
furnace-flue beyond the boiler;
en we should not have been
e account for the circumstance
The Novelty" being put *hors*
bat. A reference to the section
er shows, and your explana-
ates, that the failure was at or
he flange *a*, at which place the
t heat from the blasted furnace
es; and had it not been that
mps continued out of order, so
prevent the water from rising, a
erious *blow-up* would without
have been the result.

Braithwaite, however, asserts
the blast lessens the danger,
d of augmenting it; since, in
tion to the quickness with which
can be generated, must the ne-
of having a large store in re-
be diminished." With respect
effect of a blast upon metal,
ion will proceed in proportion to
antity of oxygen thus thrown
and every blacksmith well
knows that the metal is thereby
quickly "*burnt away*:" at all events,
the tenacity of the metal is so rapidly
diminished, and to an extent so un-
certain, that there can be *no safety* in
the application of a blast to high-
pressure boilers with *large steam-cham-
bers*, like "The Novelty." Mr. Braith-
waite is, nevertheless, right when he
states that the more rapidly steam can
be generated, the necessity of having
a large store is diminished.

This is, however, a plain acknow-
ledgment on his part of the disadvan-
tages and danger of vessels of large
capacity, and, consequently, of the
great superiority of Mr. James's boiler,
the merits of which Mr. Braithwaite
endeavours to depreciate. All that I
wish to impress upon the public mind
is, the excessive danger attending the
placing of a great store of high-pres-
sure steam in one vessel, instead of
very numerous small ones: in short,
I prefer the effect of the boys' crackers
to that of a barrel of gunpowder.

With respect, I remain, Sir,
Your obedient servant,
L. HEBERT.

20, *Paternoster Row*,
Nov. 10, 1829.

BLAST FOR BLAST.

Sir,—In an introduction to the "Evidence on the Law of Patents," in the last Number of the "Register of Arts," I was pleased to meet with the following very just and sensible observations:—"The first and most flagrant evil of the present law is, that it is not protective, but oppressive —that it encompasses the author of an invention not only with difficulties and expenses, wholly uncalled for by the necessity of the case before he can secure a patent for it, but that it exposes him to depredation by every one who may choose to *blast* his invention, or set up a prior claim to it before the patent has been sealed." Will you permit me, Sir, to ask, through your medium, whether it was in order to exemplify the way in which inventions are thus sometimes *blasted*, that the Editor of the "Register" has, in the same Number of his work, laboured so hard to blast the reputa-
tion of Messrs. Braithwaite and Erics-

son's new engine? Is it to convince the judicious, or to raise a vulgar clamoxr against a most useful invention, that he styles the harmless steam-chamber of "The Novelty" "a *blasted* chamber," and something to be more feared by the people of Manchester than "the swords of all their Peterloo yeomanry?" I have, for my part, Sir, always understood that fair play was to be distinguished by fair words, a love of truth by decency of language, and an honest aim by reliance on the judgments and not the passions of men.

I am, Sir,
Your obedient servant,
F.

Camden-town, Nov. 12, 1829.

THE SITUATION OF KING'S COLLEGE, LONDON, BAD, VERY BAD.

Sir,—I observe from a notice in your last Number, that the workmen are proceeding in the excavations and piling for the new buildings of this College. I hope that you will receive a letter of strong expostulation from our respected friend, Dr. Birkbeck, who will surely keep a sharp look-out after his "great-grand-children," whose proposed residence is to be immediately west of Somerset-house. If the worthy Doctor's professional engagements prevent his addressing you speedily, in a case in which no time is to be lost, perhaps you will allow a humble individual, whose warning voice would not be listened to, to lift up his *pen*, and state a plain fact. *In a moral point of view, the proposed site of the new College is, probably, the very worst that could have been selected in the whole metropolis, or its vicinity.* It is within about a five minutes' walk of *five* theatres, and of all the brothels and other sinks of iniquity which derive their support from those celebrated schools of morality. The consequence will be, that it will be quite impossible for the numerous students who, it is to be hoped, will enter this new institution, to go to their lectures, or return from them, by night, or *even by day*, if they deviate from the main streets, without being incessantly exposed to the most loathsome temptations. No trifling benefit resulting from the Royal grant of the land can for a moment be put into contrast with the awful and permanent evils which the Council of the College will thus invite. I trust this brief hint will suffice,

And am, Sir,
Yours, &c.
E. L. D.

Nov. 9, 1829.

MESSRS. COPE AND SHERWIN'S IMPERIAL PRINTING PRESS.

Sir, We have to solicit the insertion of the following remarks, in answer to Mr. J. Hopkinson, page 174 of your valuable Magazine. In the latter end of the year 1826, we were both with the late Mr. R. W. Cope, and John Cope was then engaged in making certain alterations in the Albion Press, which at that time it particularly required. Amongst other things he altered the pattern, so as to admit of the adoption of the adjusting wedge, which was affixed to the bottom of the piston; and presses of this construction we can point out which are now in use. This was *prior* to Mr. J. Hopkinson being in the employ of Mr. R. W. Cope. The position of this wedge was afterwards altered by Mr. J. Hopkinson (after much discussion on the subject) from the piston to the chile. We, in our improvements, have placed it in the piston of the press; and we ask, who has a greater right to make use of it than ourselves? As Mr. H. observes, without wishing to detract from the merits of any press, we must be allowed to say that we have, in the construction of our press, studied to obtain the greatest simplicity; and to offer it in such a state to the trade, as may prevent the possibility of any derangement of parts, which too often has been the source of great expense and much vexation. How far we have succeeded, we leave the trade to judge. We feel grateful for the encouragement we have already received from that respectable body; and can only say, that we have not as yet had one single printing-press returned, nor have we found it needful to keep altering our plans with every press we make.—Can Mr. J. H., with all his great scientific skill, say as much?

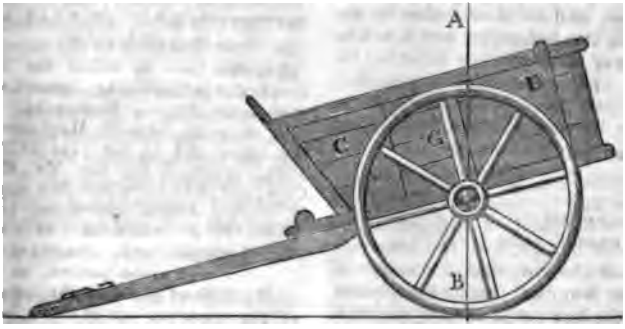
We remain, Sir, with all respects,
J. COPE AND SHERWIN.
5, Cumberland-street, *Curtain-road*,
Shoreditch, Nov. 3, 1829.

ROVEMENT IN TWO-WHEELED CARRIAGES.

;—Having in my last communi- a attempted to show the advan- likely to be gained by increasing ze of the hind-wheels in *four*- led carriages, I now wish to call ttention of your readers to *two*-wheeled carriages under a similar arrangement.

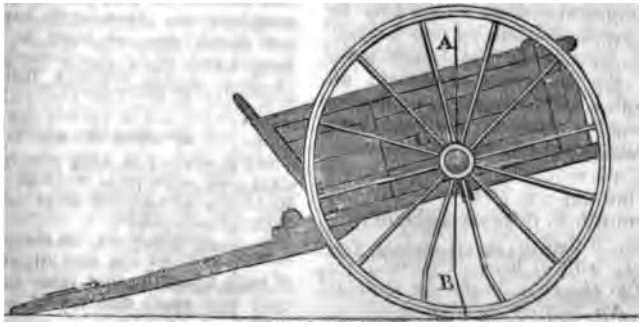
The addition of large wheels to carts, drays, &c., will, besides greatly increasing the facility of draught, tend to lessen the number of accidents to which all two-wheeled carriages are liable, from the shaft-horse falling down.

Fig. 1.



render this more evident, let t examine fig. 1, which is a ketch of a cart constructed in nal manner, and supposed to be l with bricks, stone, sand, or heavy material. While thus , and the horse is in an erect n, the centre of gravity G is directly over the axletree, in state the body of the cart is balanced, or only pressed upon ck of the horse with a force to a few pounds weight. But rse is supposed to have fallen; sequence is, that the centre of gravity is thrown much forwarder. The body of the cart and its load becomes divided by the line AB, perpendicular to the axletree, into two very unequal parts, C and D; the whole of the increased portion C, in front of the line, acting as a weight upon the horse, and only partly counterbalanced by the diminished portion D, behind the line. It frequently happens, that this increased weight, so suddenly thrown upon the shafts, snaps them short off, and at all times tends to prevent the horse from rising until part of the load is removed.

Fig. 2.



By adopting the larger wheels and the bent axle, as in fig. 2, the cart, &c., becomes much less liable to such accident, because the centre of gravity G, and the centre of suspension (the axle), are brought much nearer together; the former being placed nearly over the latter, at a small distance only from it. A horse falling with a loaded cart so constructed, will experience but little increase of weight upon him while down. The cart will be divided as before by the line AB into two parts; but it will be observed, these portions differ but little in their respective magnitudes; the centre of gravity G will be thrown forward, but in a very trifling degree.

In carts, &c., it will almost always happen that the centre of gravity will be *above* the point of suspension (the axle), but in gigs, &c., the body may be placed so low, that the centre of gravity may fall *below* that point, when the body will always maintain an erect (*i. e.* an horizontal) position; and should the horse fall down, will operate to lift him up again. A gig so constructed would be almost beyond the possibility of those serious, and frequently fatal accidents, which occur from the falling of the horse.

In the year 1817, Mr. William Aust received a silver medal and fifteen guineas from the Society of Arts, for a machine for raising loaded carts, &c., in the event of the shaft-horse falling; which is fully described in the Twenty-fifth Volume of the Society's Transactions, where it is also stated, that "the Right Hon. the Lord Mayor gave an order for several of these machines to be placed about the different districts of the City for the accommodation of the public." I am sorry to say that I have never seen the apparatus employed; although I have witnessed numberless accidents which might have been greatly relieved by its use.

I am, Sir,
Yours respectfully,
WILLIAM BADDELEY, Jun.

Oct. 21, 1829.

ANSWERS TO THE MATHEMATICAL EXERCISES PROPOSED IN NO. 316, p. 13.

Question First.

"What curve does the cross of St. Paul's Cathedral (lat. 51½° N.) describe every 24 hours?"

By Mr. J. Gilbert, Jun.

Taking the radius of the earth as 3976 miles, we shall have by plane trigonometry radius : 3976 :: cos. 51° 30' : 2475·12 miles, nearly = radius of the circle described by the cross every 24 hours.

Or the radius might easily be found by constructing a right-angled triangle, from any convenient scale, having the hypothenuse = 3976 and the angle included between the hypothenuse and perpendicular = 51° 30'; then the perpendicular will be the radius sought.

Mr. Gilbert has mistaken the drift of the question, which is one of a great deal more difficulty than simply determining the size of a circle from its radius. The curve described by the cross of St. Paul's (or any other fixed body on the earth's circumference) is a compound result of the annual motion of the earth round the sun, and its daily revolution on its own axis; while Mr. G. has merely taken the latter into account.

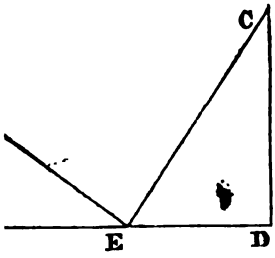
As the only two other correspondents (H. H. and Discipulus) who have favoured us with answers to this question, have fallen into the same error as Mr. G., we shall beg leave to consider the question as a *remanet* for another two months. From the proofs of mathematical talent with which Mr. Gilbert has favoured us on other occasions, we are convinced he will not shrink from the more arduous task, which the question, as now explained, presents.—EDITOR.

Question Second.

"There are two stone pillars whose perpendicular heights are 20 and 30 feet, and the distance between them 60. A ladder is to be placed at a certain point in the line of distance, of such a length, that from thence it may just reach the top of both the

Where is that point, and
he length of the ladder?"

*Thomas Hughes, Pupil of
on-house School, Hammer-
; algebraically.*



D represent the distance be-
e pillars. ∴=60 AB=20, DC
ume B2=x. ∴ ED=60−x;
$B^2+BE^2=60^2+ED^2$, each
ual to AE^2 or 60^2, or $400+x^2$
$3600-120x+x^2$. By trans-

$120x=4100$. ∴ $x=34\frac{1}{6}=$

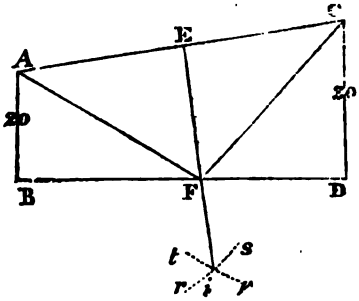
$)=25\frac{5}{6}$. Again, $AE^2=AB^2$

$=400+\left(34\frac{1}{6}\right)^2$; hence AE^2

$)+\left(34\frac{1}{6}\right)^2=39\cdot5899$

h of the ladder.

By Mr. J. Gilbert, Jun.; geometrically.



From any convenient scale of equal parts take BD=60; and perpendicularly to BD take AB=20 and CD equal 30. From centres A and C, with any equal radii large enough to produce an intersection, describe arcs *rs*, *tv*, cutting each other in *i*; join AC; and from *i* draw *i*E perpendicular to AC, cutting BD in F. F is the required point, and FA or FC, being joined, will be the length of the ladder; and referring the lengths or distances to the scale, we find FD =25·8 and FC or FA=39·6 nearly.

The following are the results of six other solutions which we have received of this question:—

	Feet.	Ft. In.
bert D. (Student, London University) makes		
the length of the ladder	39·5899	=39 6
J. Gilbert (algebraically)	39·59	
J. Greenal	39·59	
pa	39·52	
Dowling	39·6025	
. B.	39·72	

easing to observe so close an
it between so many differ-
ers; the greatest difference
only to the extent of a few

The correct answers are
en by our young friend, Mr.
(of whose early proficiency
matical knowledge we have
d so many gratifying proofs),
bert, Herbert D, and Mr.

Kappa who has worked
case by Position, will per-
the greater accuracy of the
itions, a proof of the superior
of the algebraic process in
alculations.

e of Question Third in our next.)

THE ALMANACS.

The Almanacs for 1880 will be issued to the public to-day; and this year, as last, the two chief competitors for the public favour are the Stationers' Company and the Society for the Diffusion of Useful Knowledge. We have not as yet seen any of them, but hope to be able to speak well of them all. The Stationers' Company have now officially announced a fact, which though no secret in the scientific world, has not been so generally known to the public, namely, that the whole of the Company's Almanacs have been for years under the "general scientific superintendence" of Dr. Olinthus Gregory, who had for his predecessors in the

same charge, Dr. Hutton, Mr. Rollinson, and Mr. Simpson. Well it becomes the Society for the Diffusion of Useful Knowledge and its agents to deride and vilify the labours of such men as these,—men who have done more for the cause of knowledge than all the Members of that Society put together. Much has been said of the astrological predictions contained in the Company's Almanacs; but he must be hard to please whose scruples are not removed by the following *Note* on the subject, which appears in the Company's catalogue for the present year:—

"These two Almanacs (Moore's and Partridge's) are the *only ones* published by the Stationers' Company which contain astrological predictions. These are still given from a persuasion that they *delude nobody*, and because many thousand readers are amused by tracing the coincidences which often occur between the prediction furnished by the astrological rule and the actual event. These Almanacs, however, rest their claim to public favour upon high and unequivocal grounds:—the general accuracy of their astronomical announcements, and the exhibition of *curious scientific information which is no where else to be found*. No other Almanacs give so full and complete accounts of eclipses and occultations as are herein contained. Moore and Partridge, for the present year, exhibit the type and times of immersion and emersion of an occultation, which will last *more than three quarters* of an hour, although the Nautical Almanac merely refers to it as a near approach, that is, as *not happening at all*."

PLAN FOR RAISING CARRIAGES UP INCLINED PLANES.

Sir,—After having witnessed the extraordinary effects which were lately exhibited by the locomotive engines at Rainhill, my attention was particularly directed to the working economy of what are termed inclined planes; and from an attentive consideration of the subject, it became evident that the great force or impetus which a locomotive engine and its load must acquire in descending one of these planes, might be so applied as to assist another locomotive engine and its load, in ascending the same inclin plane.

The principle here alluded to be evident, if we refer to the sk sketch, which represents a portio an inclined plane, 300 yards l and imagine that there is a loco tive engine and its load ready to scend this inclined plane; and other engine with its load ready ascend: therefore, if the descend engine is fastened to the circula chain at *a*, and the ascending one tached to the same chain at *d*

: evident that the descending and load will, by their gravi- mpetus, and the working force engine, aid the lower one to this plane.

is such a plain and simple f applying the power acquired descending locomotive, that it t require much explanation; equires what will rarely hap- . that one engine should arrive op and one at the bottom of ne at the same time, therefore st adopt another principle in apply this gravitating accele- of the descending engine for rpose intended. By again g to the engraving, we shall hat I term an auxiliary rail- arked *c*, with one side of a cir- g chain passing down its cen- rollers, while the other part chain passes along the regular . Now, let us suppose an en- at is to descend, is arrived with at the top of the plane and d to the chain at *e*, and that no engine with its load at the to be drawn up by the impe- this descending engine, then st apply to the auxiliary rail- nd hook one of the waggons, with stone, to the chain at *d*, shall discover that as the en- scends the plane, the waggon cend; and when the engine d shall, by their impetus, have l to the end of the chain at *f*, ne compensating waggon will rrived at *g*, and if it be there l, the engine may proceed on ney, leaving the waggon at the part of the inclined plane. let us suppose an engine *h* is moving in the contrary direc- arrived at the bottom of the nd fastened to the chain, and e waggon which had just been up by the descending engine, n liberated from its stop at *g*, shall perceive that this wag- ll descend this auxiliary plane m accelerating force; conse- y, aid the engine *h* to ascend clined plane, and as the de- f the auxiliary plane is longer at of the railway, this waggon ntinue to aid the ascent of the *h*, until it has arrived upon the level part of the railway, when it can again be liberated from the chain, and proceed on its journey. Here then we see a complete developement of a principle by which descending engines may furnish us with a compensating power, that may be applied to draw loaded engines up an inclined plane; and if for each engine that descends this plane, there were another to ascend the hill by this means, only one loaded waggon would be required on the auxiliary railway; but as that may not always be the case, the auxiliary railway should be supplied with six or eight of these loaded waggons, as shown by the diagram, to provide for any temporary difference in the number of engines passing and repassing along this inclined plane. This short sketch may be sufficiently illustrative of the new principle intended to be introduced into railways, but for practical purposes a greater amplification will be required, which I will gladly furnish to the committee of any intended railway company, where this principle can be applied, if they think it worth while to address me on the subject.

If the plan here proposed should work well in practice, its advantages over that of stationary engines, for the purpose of inclined planes, are so obvious, that no comparison will be required to establish its superiority.

I remain, Sir,

Yours, very respectfully,

JOHN BYWATER.

Liverpool, Oct. 29, 1829.

[The preceding plan, which we copy from the *Liverpool Chronicle*, at the request of a friend of the author, is very ingeniously stated, and has every appearance of being original with the writer. Mr. Bywater will be disappointed to learn, however, that it is by no means new either to theory or practice. Mr. Sylvester, in his pamphlet on railways, (1824), after stating, that "an apparatus may be connected with the fixed engines (at the top of inclined planes), which will confine the office to the *difference of weight* between the goods going different ways," gives all the details of a plan for the purpose. Mr. Deakin, of the Blaenavon Iron Works, has also proposed a similar mode of operation for conveying ore from a mine, in No. 304 of this work, p. 711.

And in the American Journal of Science, for April, 1828, the earth of the deep cuttings of the Welland Canal is stated to be removed on a like reciprocating plan—"the loaded descending teams drawing up the empty ascending ones." In America, the plan is claimed as a recent invention of one Oliver Phelps; but we believe there are few excavators in this country with whom it is not an old acquaintance. It is not long, since thousands in the metropolis must have seen it in practice in digging the foundations of the new London Bridge.—ED. M. M.]

DESCRIPTION OF THE GOLD COIN REPRESENTED IN NO. 320.

Sir,—I have only just received the September Part of the "Mechanics' Magazine." If your correspondent, Mr. H. S. Guy, has not already received the information he wished, you can give the following:—

The coin represented at p. 86, is the angel, first coined by Edward IV. in his 5th year. Henry VI. struck angels, but only during his short restoration, A. D. 1470–71; therefore, Edward's were the earliest.

The obverse has the archangel, Michael, trampling upon the dragon, and thrusting his spear into its mouth. The legend,

EDWARD DI GRA. REX ANGL. Z FRANC

The reverse bears a ship, with a cross for the mast. In centre, a shield with arms of England and France quarterly; on one side of the mast E, the initial letter of Edward, and on the other a rose. The legend,

PER CRVCE TVA SALVA NOS XRE REDEMTOR.

The angel is common; its weight should be 80 grains. Fineness, 23 carats 3½ grains fine gold, and ½ grain alloy. It was made current at 6*s.* 8*d.*, the value of the old noble, and hence sometimes called the noble angel.

I am, Sir,
Yours, &c,
Δ.

[A similar description to the preceding, but not so full, has been *received from X.*]

MINOR CORRESPONDENCE.

Effects of Mercury on Gold.—Sir, I was somewhat surprised in reading in No. 316 of your valuable work, the article headed "Deterioration of Gold by Mercury," at the effects there ascribed to mercury. I am a goldsmith, and have had sometimes to do with mercury, but was not aware it rendered the gold brittle. In every instance where I have seen the two substances in contact, instead of the gold retaining its colour, like the sovereign there mentioned, it was rendered of a whitish hue; but this whiteness was easily dissipated by the application of gentle heat. If the contaminated article is placed on a piece of warm metal, or over a lighted coal, you may perceive the evaporation of the quicksilver.

I am, &c. W. S.

Consumption of Smoke.—Sir, In No. 304 of the "Mechanics' Magazine," under the head of Minor Correspondence, there is an offer by a Correspondent to communicate "a plan that will completely consume the smoke arising from a steam-engine fire, and well adapted for locomotive steam-carriages, as it will occupy but little room, and not require any extra fuel."—I, Sir, am disposed to treat with the writer upon liberal terms; but I would first beg of him to state in one of your earliest numbers, whether the consumption of the smoke is effected without the consumption or abatement of heat in the fire, by the admission of cool air, which would produce that effect.

I am, Sir, yours respectfully,
A PROPRIETOR OF A FOUNDERY.
Birmingham, Nov. 3, 1829.

A Correspondent at Weymouth announces to us the death, at that place, on the 6th instant, of Mr. John Harvey, aged 71, "mechanic to our late-revered monarch, George the Third; one of the first proprietors of the Weymouth Water-works; late civil-engineer of the Bootle Water-works, Liverpool; and the original projector of the Breakwater for Portland Roads."—Mr. Harvey was a man of great ingenuity and worth, and much beloved and esteemed by all who knew him.

Self-loading Cart.—The *Richmond Compiler* contains a notice of a singular cart, invented by a Mr. W. Beach, of Philadelphia. It is described as loading itself by means of one of the wheels, which is hollow, scooping up the earth as it revolves round. A cart of this construction is stated to be at work on the railroad, within a mile and a half of the Schuylkill river, near Philadelphia. It is worked by a man and a boy; and removes and embanks in a day twice as much earth as is accomplished by three common carts and twenty men.

INTERIM NOTICES.

We are sorry we cannot give Mr. W. D. the information he requests respecting a certain work. Only four Parts of it, we believe, were published.

Communications received from H. J.—B. S. A.—R. C. Jun.—Henry D—O. C. F.—Bractstone—Mr. Baddeley—Mr Kingsnorth—A Constant Reader at Ludlow—E. W.—Mr. Gilman.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 328.] SATURDAY, NOVEMBER 21, 1829. [Price 3d.

AMERICAN RAILWAY-CARRIAGES.

Fig. 1.

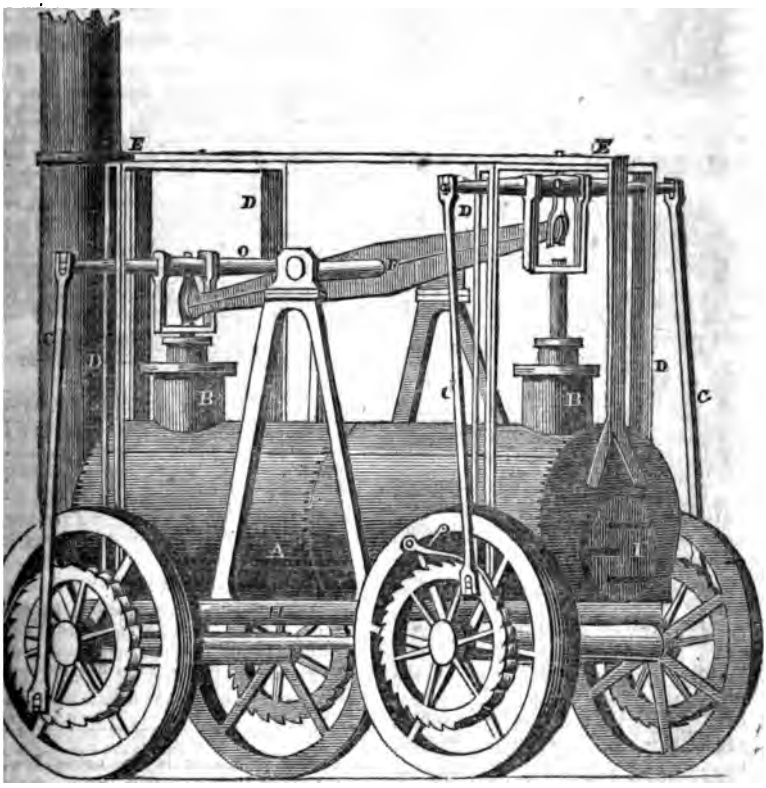


Fig. 3.

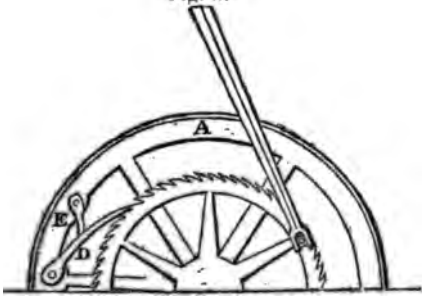
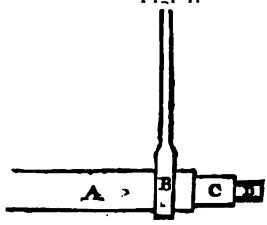


Fig. 4.



AMERICAN RAILWAY-CARRIAGES.

The advantages of railway conveyance are beginning to be as sensibly appreciated in the United States as in this country. A railroad of unexampled extent is now in the course of formation from Baltimore across the Alleghany mountains to the Ohio; and railways between most of the principal towns in the Union are stated to be also in contemplation.

The engineers of the Baltimore line were not long ago in England on a visit of inspection to our different railways; and as Jonathan is a shrewd observer, we may expect to hear before long of his having discovered many things in our practice to amend as well as imitate.

It must be confessed, however, that as yet the Americans are considerably behind us in all that relates to railways and steam-carriages; and in this as in other matters, incline but slowly to a reciprocal system. They treasure up all the good things devised on this side of the Atlantic, but favour us with very few of their own in return. Upwards of nine different locomotive plans have been brought forward within the last thirty years, but not more than three or four of these have been of American origin. The backwardness of the Americans in this particular line of invention is the more surprising, considering that it was in America the practicability of travelling by steam on land was first promulgated with due boldness. The English appear to be playing the same part precisely, in regard to steam-carriages which the Americans did in regard to steam navigation. Fulton, as every one knows, only carried into effect on the lakes and rivers of the western world, plans which he had previously seen reduced to practice, but, for want of adequate encouragement, laid aside in Scotland; and the Braithwaites, Stephensons, and Gurneys, of our own times, are but realising in England the "chimerical" projects (as they were called by the sages of Philadelphia) of the ingenious Philadelphian, Oliver Evans, who, thirty years ago, first pronounced travelling by steam on land a possible thing; so possible, that he did not *hesitate to predict* "the time would come when carriages propelled by steam would be in general use, as well for the transportation of passengers as goods, travelling at the rate of fifteen miles an hour, or thirty miles per day!"

The persons who next to Evans have most distinguished themselves in connexion with terro-locomotion in America, are Mr. Winans and Mr. Howard.

Mr. Winans has invented a new description of wheels, which the Board of Engineers of the Baltimore Railway have resolved on adopting, in which friction is so much reduced, that if we may credit the statement of a Mr. Sullivan (the partner of Mr. Winans), in the Journal of the Franklin Institute for April last, a steam-carriage with these wheels will draw nearly four times the weight it could with wheels of the common construction. Mr. Winans has obtained a patent for his invention in the United States, and he is now in this country soliciting a similar privilege for Great Britain. We have perused Mr. Winans's American specification, and had the pleasure of examining a waggon with wheels on his principle, which was exhibited at the late railway competition, as also of witnessing some trials made with it; and we are well satisfied, that the reduction of friction realised, though by no means so great as Mr. Sullivan has represented, is at least so considerable, that great gain, both in point of speed and economy, must result from their adoption.* As Mr. Winans has not

---

* The following is an account of some experiments which were made with this waggon on the Liverpool and Manchester Railway during the week preceding the late competition:—

	tons.	cwt.	qr.	lb.
"The carriage and wheels weighed	0	11	1	3
And was loaded with pig-iron	3	0	1	21
Making a total of weight to be moved	3	11	2	24

A contrivance for ascertaining the requisite power or weight to move the above was used, that had previously obtained the sanction of two eminent engineers; and every means resorted to, to obtain a fair and impartial result. The carriage and weight were moved

rolled his English specification, ; we believe it will include some al improvements, which have nly devised since the patentee en in this country, we shall not ore at present of the principle on the wheel is constructed, than consists in an application of the friction-rollers, or wheels, at genious and simple, and, as far are at present aware, perfectly d.

Howard is the inventor of the y-carriage of which we gave a tion, with drawings, in our Number. The chief peculiari- that carriage were the intro- a of a jointed perch, for the e of enabling it to take curvi- turns with ease, and the adop- friction-wheels on a plan dif- from that of Mr Winans, and means so good. Mr. Howard ce produced another carriage, ch he professes to have greatly ed his method of enabling car- to travel on curved rails; and

---

he road at various speeds, and Olbs. 12lbs. 15lbs. 17lbs. and from which the following pro- ate results were deduced:—

	Miles per hour.
ved 334, and kept the ings moving	4½
ved 470, and kept it ing	3
ved 616, and kept it ing	2½

notion was first given by other o the carriage, then

	Miles per hour.
th 617, kept it moving h 800, kept it moving.	4½

12lb. 12 oz. and upwards were bring the carriage and load for- t invariably gained in speed.

1 the whole, the results were satisfactory; and from them it ppear, that a horse's work on -road, at a slow speed, may be to approximate much nearer to k on a canal, than perhaps had nerally imagined. One point to be fully established, that this e has greater advantages under a eed than under a slow one; for, onsiderable speed was given at r other power, the speed was ept up or increased by the re- weights than when tried under peed."—*Liverpool Chronicle.*

this invention we now proceed to describe.

Figure 1, on the front-page of our present Number, exhibits a perspective elevation of Mr. Howard's "Improved Locomotive-Carriage;" fig. 2, (next page) a back view; figs. 3 and 4, parts of the wheels to illustrate more clearly their peculiar mode of action. The same letters of reference refer to the same parts in figures 1 and 2; and to make the peculiar improvements which Mr. Howard has here introduced the more easily recognised, his friction-wheels, and some of the minor details of steam apparatus, are omitted.

The first desideratum which Mr. Howard has made it his study to accomplish in this engine, has been to render the axle-trees capable of adapting themselves to the curve of the road, so that a perpendicular plane drawn through the centre of the axle may be normal to the curve. His arrangement for this purpose we shall give in his own words:—

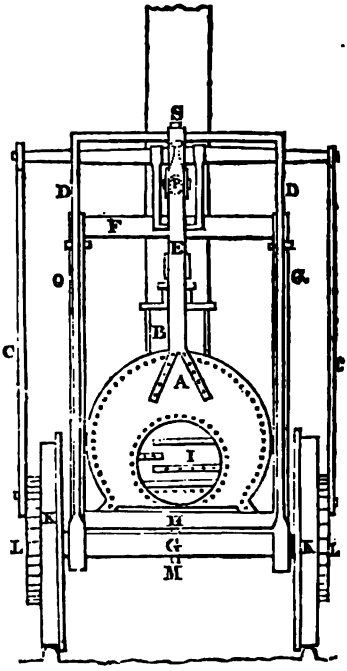
"The usual beam fastened by jaws to the axles, is divided in the centre, and a tooth and socket permits one end to play in the other. This contrivance, as shown in my improved railway-carriage, obliges the hind-wheels to follow in the track of the fore ones. Besides this, there is a beam extending from one axle to the other, and traversing on the centre of each, round a strong bolt. To this beam, the boiler A, with the cylinders BB, are attached. The boiler, indeed, may be made to answer the purpose of this beam, by placing it upon beds HH, beneath which the axles GG move horizontally around centre bolts. At each side of the boiler, and attached to the axles, and moving with them, are perpendicular supports or guides DD, with openings for the vertical motion of the ends of the shackle-bars OO of the piston-rods; each pair of supports, or guides, being connected at the top by an iron bar, in the centre of which is a bolt connecting it with an iron frame EE, passing lengthwise from each extremity of the boiler to which it is fastened, and which keeps the supports, or guides, in their vertical position. This last bolt is directly over the bolt of the waggon-bed, as well as over the

centre of the cylinders, so that when the axle moves horizontally around the waggon-bed bolt, the supports, or guides, moving with it, make the bar connecting the supports, and which is always parallel with the axle, revolve round the bolt in the frame above the boiler and cylinders, which are stationary; and the shackle-bar moving at the same time horizontally, with its guides, around the head of the piston-rod, which is constructed to allow of such motion, the horizontal motion of the axle does not interfere with the working of the engine. To preserve a uniformity of motion, a balance-beam F, supported from the boiler-bed, is connected with the shackle-bar of each piston-rod, so as to allow of its vertical motion, and, at the same time, the horizontal motion occasioned by an alteration of the direction of the wheels. In this I claim as original, the principle of making the shackle-bar traverse round the head of the piston-rod, and the means by which this is accomplished."

The next point to which Mr. Howard has directed his attention is the means of making the outer wheels go faster than the inner, which he accomplishes in this way:—

"The axle revolves as usual in railway-waggons, and the carriage-wheels revolve likewise upon the axle; but at the extremity of the axle there is a ratchet-wheel L fastened, to the rim of which the connecting-rod C from the shackle-bar is fastened, instead of to the carriage-wheel K, as is customary. From the rim of the carriage-wheel there is a catch and spring ED, fig. 3, striking the teeth of the ratchet-wheel, and uniting the two as one wheel, except when it becomes necessary that one carriage-wheel should, in describing a large circle, go faster than the other, or, in other words, faster than the axle and ratchet-wheel. The carriage-wheel then moving faster than the ratchet-wheel fastened to the axle, the spring and catch on the rim slide over the teeth of the ratchet-wheel, until a straight motion makes the catch hold the teeth again, or a reversed curve causes the opposite wheel to perform the *same* operation. So that the engine, *notwithstanding* the altered velocity of the wheels, still performs its motion with regularity; no change ever taking place in the velocity of the ratchet-wheels."

Fig. 2.



In fig. 3, A is the carriage-wheel; D, the catch; E, the spring. In fig. 4, A represents the axle; B, the supports or guides; C, the shoulder for the carriage-wheel; D, the octagon for the ratchet-wheel.

MESSRS. BRAITHWAITE AND ERICSSON'S BOILER.

Sir,—It appears by your Magazine of yesterday's date, that your correspondent "F" thinks, or would have it thought, that I have been guilty of intolerable heresy, by expressing an unfavourable opinion of Messrs. Braithwaite and Ericsson's boiler; and, inquisitor-like, he puts various interrogatories to me, which have but little to do with the subject at issue. If I was actuated, as he insinuates,

rorthy motives in expressing inion, it is not likely I should ledge the fact, and the denial ould avail me nothing. The n is, simply, one of science; , whether is Braithwaite and n's boiler very liable to explo- not: my observations and ex- e lead me to the conviction s.—Ought I then, as the editor rk on mechanical science (to n certain portion of the public information on such subjects), in the chorus which has been ally chanted in praise of this and breathe not one word of gn, in order to please the fas- taste of " F," who seems to in empty compliment, more ie public safety? Instead of in insinuations, would it not e creditable to " F" to treat ter scientifically, and show by easoning that my arguments nded in error? *Until that be shall consider that I have both id sound sense on my side.*

am, Sir, respectfully,
Your obedient servant,
L. HEBERT.

ernoster-row,
. 15, 1829.

R OF MR. BRAITHWAITE TO MR. HEBERT.

-I regret that I feel obliged extreme disingenuousness ma- l by Mr. Hebert, in your last r, again to intrude myself on ention of your readers. I l him with a gross misrepre- n, in stating that the *boiler* of Novelty" gave way in conse- of the application of a blast *furnace.* He now admits, or o admit, that he should have ted for the word *boiler* the *ve of the furnace.* But being out of this pretext for his cen- the engine, he now gives us to and that *if* the furnace-flue t given way, the boiler inevi- ould. " Had it not been," he that the pumps continued out r, so as to prevent the water sing, *a very serious blow-up without doubt, have been the* result." Now as the pumps were not always, but once only, out of order, it should follow, if Mr. Hebert were right in his assertion, that on each separate occasion, when the pumps worked well, and the boiler was kept fully supplied with water, there should have been a separate " very serious blow-up." It should follow, too, that the engine to which you, Sir, have alluded, in your last Number, as having been at work for many months at my factory, (the boiler of which I may observe, by the way, is of copper, only one-half the thickness of that of " The Novelty,") should have had so many " very serious blow-ups," that it ought long ere now to have been blown to pieces. Need I ask your readers which is to be most regarded —Mr. Hebert's allegations of what would and should have happened— or the evidence we have before us of what actually did happen? Need I insist on the unfairness of thus shifting from fact to prophecy after the fact, and dealing in all manner of random assertions, in order to bring discredit on a mode of generating steam, which, as far as it has been yet tested by experiment, promises fairer than any other which has been brought before the public?

Mr. Hebert, it deserves to be kept in mind, never once disputes the great assistance which may be derived from a blast; he questions only the possibility of employing it with safety to the materials exposed to its influence. Now the ground on which the proprietors of " The Novelty" take their stand is, that they do employ a blast with perfect safety. The question is not one of argument, but of fact, and only in as far as facts bear them out in their pretensions do they hope for success.

I have no wish to be drawn into a controversy with respect to the merits of any rival engine; but as Mr. Hebert insists on twisting some expressions of mine into an admission of the superiority of that of his friends, Sir J. Anderson and Co., I may be allowed to explain what it is I really admit. Mr. Hebert says, " Mr. James's boiler is the only one I have hitherto seen, that is adapted to locomotion by steam power, whether in carriages or boats,

on account of its perfect safety, there being no magazines of steam, which are more than about an inch in diameter." Now, it must be extremely obvious, that the *working capabilities* of an engine, and the *degree of safety* attending it, are two things as different as the poles are asunder. An engine may be well adapted to locomotion "*on account of its perfect safety*," which is not adapted to it on any other account whatever. I admit, as every one must, that the smaller the steam-chamber the less the danger; but I must be allowed to maintain on the other hand, that this, like other principles, may be carried to such an excess as to be good for nothing in practice. How far Sir James Anderson and Co. have kept within the limits of practical utility remains yet to be decided. I have not presumed, nor do I presume, to predicate any thing of their engine: feeling well content to leave to others the ungracious task of *undermining* by surmises, and *blasting* by anticipation.

I remain, Sir,
Your obedient servant,
JOHN BRAITHWAITE.

1, *Bath-place, Fitzroy-square*,
Nov. 17, 1829.

THE ALMANACS FOR 1830.

We announced in our last Number the appearance of these heralds of the coming year; and having since examined with some care the contents of their different wallets, we now propose to acquaint our readers with the result of our scrutiny.

We find the "British" much the same as it was last year, which, considering that it was not *absolutely* perfect last year, we think a pity. It has been put forth as the very *beau-ideal* of almanacs—as at once a reproach and a model to others; and cannot, therefore, well afford to be any thing less than superlatively excellent in all respects. We ventured last year to point out some very palpable faults in this almanac, and were the medium of pointing out others, detected by much abler hands: but as there is nothing on which the Society for the Diffusion of Useful Knowledge have insisted more than the propriety of being in constant harmony *with the march* of improvement, we *took it for granted* that we should this year have praise unbounded, to bestow on them, for the promptitude and cordiality with which all these faults had been remedied. Our readers may judge how deep our mortification must be, to find that all our admonitions and all the admonitions of our friends have gone for nought; and that the men we expected to see keeping steadily in the van—who took upon themselves the honourable post of pioneers to the army of almanac-makers—have shown themselves just as backwardly inclined, as fond of skulking among the baggage-waggons, as the worst of their neighbours.

Of this early degeneracy we have a notable proof at the very opening of this year's almanac. At pages 5 and 6, we have a table of high-water at London, and an explanation of that table founded on certain theorems of Laplace. The history of the Society's efforts in this department grows more and more curious with the lapse of time. In the first almanac they published—they borrowed (we like soft phrases) their tide-table, with much other valuable matter, from the almanacs of the Stationers' Company, and for that year their *tide-table was correct*. When the Stationers' Company complained that it was rather too bad in the Society, to borrow so much from works, which they were at the same time in the constant habit of holding up to public derision for their utter worthlessness, the reply of one of their encomiasts and defenders was, "Oh! such computations as these are not worth talking about; they could be done for the reward of a guinea by any mathematical usher in any writing-school in the kingdom." Well, rather than borrow again from the Company's almanacs, the Committee had the tide-table for their second almanac compiled by some such "mathematical usher," whom, it is to be presumed, they so rewarded; and the notorious result was that the times of high water *were for that year generally more than half an hour wrong*. Good reason this was for trusting no more to ushers and guinea fees; and now the Committee appear to have bethought them of the old adage, that "if you wish a thing well done, you should do it yourself." The charge of this department for the year 1830 was accordingly transferred to one of their own body,* who, as if it were not

* The gentleman certifies his labours by his initials only, "J. W. L."—but the reader can be at no loss, with the help of the List of the Committee, to supply the letters which modesty has kept concealed.

enough to confound all carpers, that he is a member of so learned a Committee, and a Fellow, to boot, of two most learned Societies, makes his *debut* as a computer under the favour and protection of some theorems from the illustrious Laplace. What is now the result? We regret to say, only worse and worse. For once the adage has been falsified, and the Committee have *done for themselves* in more senses than one. It so happens, that the theorems of Laplace, which the computing member of the Committee has here made use of to determine the time of high-water at London-bridge, were not intended to apply, and can never apply correctly beyond 50° of N. latitude. We shall not at present detain our readers with a demonstration of this easily demonstrable fact, but shall content ourselves with pointing out the practical blunders into which this employment of an inapplicable theory has betrayed the Society's computer. On the last day of 1829, it will, according to the Society's almanac for 1829, be high-water at London-bridge as follows:—

Morning.		Afternoon.	
h.	m.	h.	m.
6	17	6	39.

And on the day after, namely, the 1st of January, 1830, the times will, according to the same Society's almanac for 1830, be

Morning.		Afternoon.	
h.	m.	h.	m.
6	1	6	25.

That is to say, it will be high water on the 1st of January next a quarter of an hour earlier than the day preceding!!! But we shall be told perhaps that all this arises from the blunders of the discarded "usher," and that though the times for the 31st of December, 1829, may be wrong, it does not follow that those for the 1st of January, 1830, are wrong also. Granted. Let us compare, therefore, the times as given in the "British" with those given in any of the Company's almanacs most distinguished for their accuracy. The time of high-water on the morning of the 1st of January, 1830, will, according to White's "Ephemeris," be 6h. 23m. and in the afternoon 6h. 53m.; that is, in the one case twenty-two minutes, and in the other twenty-seven minutes later than the times given in the "British!" Who can doubt which is right? Who would place more reliance on the computations of a novice, than on those of a work, long renowned throughout the world for its scientific correctness, and praised by *none more than by* Laplace himself? Neither are the Society's errors of the 1st of January solitary errors; for on almost every day of the year, the times of high-water, as given in their almanac, are nearly to as great an extent erroneous. The truth is, that had the French theorems, which have been employed for the computation of the Society's tide-tables, been even applicable to our northern latitude, they could have been of little use in the hands to which that computation has been entrusted. It is evident from the attempt which he has made under the head of "Explanation," to make the symbols of Laplace more intelligible than they are in the *Mecanique Celeste*, that he does not understand them. He has transformed very excellent philosophy into very precious nonsense; and this no one who knew what he was handling could well have done. A promise is given that the method of computation which he has adopted will be "explained at some length in the Companion to the Almanac" (for 1830), and a "coincidence shown between theory and observation" which "is truly wonderful." But this "truly wonderful" coincidence must of course have reference to past computations and past observations. And what we would beg to ask, and volumes of such like nonsense prove should it turn out to be so, is that certainly will—that the work's own computations for the future year do not coincide in one instance out of ten with the actual fact? Simply this, that though other computers have been able to turn the theorems of Laplace to good account, the computer for the "British Almanac" has misapplied them altogether. Goethe says somewhere, with great truth, that whoever deals with symbols *only* is the neglect of the spirit of things, must either be a bungler or a charlatan; and we may rest assured, that the computer for the "British" will form no exception to the rule.

The "Weather" column of the "British" was another department of this almanac with which fault was very generally found last year, and in which there can be no doubt many useful improvements might have been made. But instead of any improvement being introduced, or even attempted, we have precisely *the same information*—word for word—under this column, which we had last year. Not a single error is corrected (though many were pointed out); not a single emendation made; not a single new fact added. If this be not obstinacy of the worst kind, what is it? It will be recollected, that the Society

professed to furnish under this head merely certain averages "calculated for London," but averages which would "apply to a *very large circle* around." Why not then have presented us this year with some analogous remarks suited to some other meridian than London? Why not have made the circle of application still larger? It seems that "very large" as that circle is, it is by no means so large as the language of the Society might lead people to suppose. A person has been writing to them from Woburn in these terms:—"From my constant observations from the commencement of the year to the present day, I have invariably found your weather-table altogether wrong." The answer which the Society make to this blunt charge is such as, we dare say, the author of it little looked for. "It would appear scarcely necessary," they say, "to impress upon any mind, acquainted with the *commonest principles of science*, that the computations which are given in the column of "Remarks on the Weather," are *averages* deduced from long observation," &c. "It would be less *irrational*, if he were to say to the inspector of Corn Returns, 'From my constant notice of the price of wheat in Woburn market, I find your average prices quite inaccurate.' When people have been accustomed to believe in the absurdities of the weather prophecies, it is difficult to satisfy them with *common sense*." Now passing over the excessive civility of this answer—a civility so peculiarly becoming a body of men associated for the purpose of eliciting and disseminating truth—passing over also the question of the *irrationality* of supposing that a place 43 miles from London, might be included in the "very large circle around" it, to which the Society's calculations were said to apply (which is all the offence the Society's Woburn correspondent has been guilty of); let it suffice that we learn from their answer this important fact, that the "Weather Table" of the "British Almanac" is admitted by its authors to be confined in its application to a circle around London, which though called "very large," is, in truth, something of greatly less than 43 miles radius! In all other parts of Great Britain it can, of course, be of no practical use.

The same useless repetition which disfigures the "Weather" column of the "British," is equally observable in its column of "Anniversaries." It was suggested last year to the Society, that the greater diversity they could introduce *under this head*, the more "useful knowledge" they would diffuse; and that there was no day in the calendar so undistinguished by great men and great events, as to make it difficult to give an entirely new list for every year. It was further observed, that there were a great many blanks in this column, which, as the Society does not profess to be one for the diffusion of waste paper, ought at least to be filled up—if even only once for all. Who can say there was aught but good sense and good feeling in these suggestions? Or differ from us in stigmatizing, as most blameable, the inattention which has been shown to them? The column of Anniversaries is, like that of the Weather, nearly, if not entirely, the same as it was last year, and there are still as many unoccupied spaces as ever.

The paucity of astronomical information is another defect in the "British," which has existed from the first, and is still as remarkable as ever. The editors seem to be amazingly shy of every thing that would involve them in any new and independent computation of their own. They have ventured this year, with the help of a pair of globes, and of such other lights as are common to the sphere of seminaries for young ladies and gentlemen, to give, on their own authority, the positions of the principal stars and planets for each month; but for every thing of a more recondite description they have been content to have recourse to others. Of *Eclipses* which are to take place in 1830 they tell us but little, and that little is abridged from the "Nautical Almanac." Of *occultations* they say nothing at all. "Partridge" describes ten of these appearances; "Moore" five; the "Englishman" five; the "British" none. It would seem as if the editors of the "British" thought such phenomena beneath their notice; yet so differently is their importance estimated by the Astronomical Society, that they publish an anticipatory list of them monthly.

The astronomical information in the "British" is not only scanty but often inaccurate. The Tide Table, of which we have before spoken, is but one series of blunders; and the positions ascribed to the Stars and Planets are, like the times assigned for high-water, seldom more than distant approximations. But if errors of thirty or forty minutes excite our surprise, what shall be said of an error twenty times greater? in the position—not of any obscure planet—but of the Sun itself? At page 20, it is stated, that the Sun enters Cancer 21st

June, 11 h. 50 m. *morning*, when, of course, the summer quarter should commence; but we are elsewhere assured (p. 7.) that the summer quarter does not begin till June 21, 11 h. 50 m. *afternoon*, that is, twelve hours later! Do the Superintending Committee of the Diffusion Society vouch for the correctness of *both* these statements?

The *Saints' Days* have been all along sad stumbling-blocks to the editors of the "British." They seem originally to have regarded them as relics of a superstitious era, which it became them, as the champions of a general purification, to disown altogether. But though they ought long ere this to have found out that their zeal in this respect was without knowledge, and that while there is in truth nothing in a name, abstractly considered, there is great practical convenience in preserving the names which have been attached amongst us from of old to particular days; they show a coyness and fickleness in yielding to the expediency of the case, which is nothing more nor less than simply ludicrous. They will not recognise all the saints in the calendar, only a few; nor will they assign any reason why they recognise some and discard others, only that it is their whim. They leave out, for example, St. David, while they retain St. Patrick; degrade our old friend, St. Crispin, the patron of the coblers, while they do due honour to St. Clement and his blacksmiths; bogle at St. Chad and St. Alphage, while they doff their caps to Saints Barnabas and Bartholomew. What good reason can possibly be assigned for such distinctions as these? The editors of the "British" should either retain *all* the saints' days that have been heretofore known to our calendars, and are still, as it happens, under the ægis of legislative protection (Lord Macclesfield's Act), or they should omit them all. They may imagine, perhaps, that it is matter of moonshine which is omitted and which inserted, or whether any or all have a place; but if they do, they are greatly mistaken. There is not a saint in the calendar, however obscure or disreputable, whose name is not identified with a *public day*, held somewhere or other in the country by some corporation or craft, or particular class or body of people; and every omission of the kind is to a greater or less extent a positive practical inconvenience. The name, as we have before said, is nothing; it is the anniversary with which it is connected, which makes the preservation of it of importance. *What, for instance,* can we have less to do with at this time of day than the translation of that personification of priestcraft, Thomas à Becket! Yet the first week after that translation is the period appointed throughout the whole of North and South Wales for one of the quarter-sessions of the justices; and *quoad hoc*, the commemoration of the day is not useless. We believe there are some persons with whom the word *Saint* is in bad odour on religious grounds; but could not the Society manage to satisfy the scruples of those persons without striking the names altogether out of the book of memory? Can they not give the principal names merely, dropping the addition, as Barnabas for St. Barnabas, Crispin for St. Crispin, &c.? We have no objections for our own parts to their uncanonizing the whole batch; but must insist on the propriety of the names being preserved in some shape or other. Names are much better helps to the memory than dates, and none can be more so for the purpose than those which have been consecrated by long usage.

In the *Moveable Feasts* and Terms, the "British" is not so erroneous this year as it has been; but still erroneous. At p. 8, the Oxford Easter Term is said to end May 25th; it should be May 29th. In the same page, Oxford Michaelmas Term is said to begin October 11th; it should be October 10th. The same mistakes are repeated in the May and October pages. It is due, however, to the Society to state, that they are all four carefully *copied* from the "Nautical Almanac."

The column which was last year occupied with the Garden Plants in Flower, is filled this year with the Common Indigenous Field Plants in Flower. The substitution is judicious, and might be referred to as a proof, if any were wanted, how much better new matter is than old—how much more instructive to the reader, and more creditable to the industry of the compilers. The Society might, with just as much propriety, have insisted that only one set of plants should be in flower every year, as that the same events and no other should be recorded year after year.

Another commendable change is observable in the substitution at the bottom of each page of the "Fish in Season" for the "Meat, Vegetables, &c. in Season." But the merit is more in the intention than in the execution. Among other curious things which the reader will learn from the Izaak Walton of the Society, is the fact, that oysters are never *finest*, but that tench are

finest in January, *finest* in February, *finest* in March, *finest* in April, *finest* in November, *finest* in December!

The "Useful Directions for each Month," which last year followed the "Calendar," are in the present almanac wholly omitted. It would have been scarcely tolerable to have had them, like other matters, served up a second time: but could not the Society have contrived among them to furnish something new under this head? Is their whole stock of prudential knowledge exhausted?

The "Miscellaneous Register" contains the usual lists and tables, and one quite new which we think will be found of great value. It is a list of the mail-coach routes direct from London," which by "the kindness of the gentlemen connected with the mail-coach inspectors' department at the Post-office, has been rendered minutely correct." This list will enable persons "to ascertain the time of receiving and delivering letters as well as of forwarding parcels," and "a very trifling computation will enable them also to ascertain the time of the mail passing any of the places between those mentioned." One column gives the distance of each place in miles from London, measured from the (New?) Post-office; and a second and third, the times of the mail's passing "*from* and *to* London." One simple but very useful improvement we would beg leave to suggest in this table. Each route is thus headed, "Birmingham and Banbury *from* the King's Arms, Holborn-bridge." Instead of the word in italics, we would substitute the words "*from and to*," and persons would thus see at once that the routes serve as well for going to, as coming from the metropolis.

Minutely as we have gone through the contents of this almanac, we suspect that, after all, we have overlooked the most truly *sterling* page in it, namely, the title-page, which exhibits in imposing array the names of the hundred and thirty-seven persons of learning and distinction under whose auspices it continues to be ushered into the world. It is but too evident, the compilers of the "British" trust a great deal more to the influence of these names than to the contents of the almanac itself for success. Had they looked only for the patronage which follows upon desert, they would never have displayed so obstinate a disregard as they have done to *the reasonable, earnest*, and repeated *calls for amendment* which have been addressed to them. They would never have committed so many blunders as it has fallen to our lot to detect and expose. They would have shown more readiness to please; more anxiety to be useful; greater industry in the collection of facts, and greater care in giving them to the world. But if the Editors be so much to blame, what shall be said of the Superintending Committee? What becomes of their *superintendence*, if such carelessness, neglect, and incapacity, as we have presumed to censure, are allowed to pass unheeded and unchecked?

We have left ourselves no room this week to enter into the merits of the rival almanacs of the Stationers' Company; but we cannot let pass the opportunity of commending them generally for the spirit of improvement which pervades them. It seems to us likely that the Society for the Diffusion of Useful Knowledge will do a great deal more good by the exertions to which they are stimulating the old and practised hands in the art of almanac-making, than by any thing they will ever themselves be able to produce in this way. The Stationers' Company never published any thing half so good as the "Englishman," (if we except "White" and "Lady Di.") which may be said to owe its existence entirely to the rivalry of the "British." It is of the same number of pages as the "British," and sold at the same price; but we think we may say without exaggeration, that it contains at least one-third more matter, and that all of the very best description. Every corner of it is literally crammed with rare and useful information. The Company have, in the same active spirit of competition which gave birth to the "Englishman," produced this year another new almanac, called "The Tradesmans' and Mechanics'," which is nearly as good in its way, and will be found particularly well suited to the class of persons for whose use it is designed. But of these almanacs and their merits, and of the whole subject, more in our next.

Acoustics.—Captain Parry, in his Third Voyage, p. 58, relates, that a conversation could be distinctly carried on at Port Bowen, at the distance of 6000 feet. Dr. Clark, however, mentions a more extraordinary instance of the propagation of sound. He asserts, vol. iii. p. 331, that while sailing from the Gulf of Glaucus to Alexandria, the firing of the English, in attacking the fortress of Rachmanie upon the Nile, was distinctly heard by all on board, a distance of 130 miles.

COMPARATIVE VIEW OF LAND AND WATER ON THE EARTH'S SURFACE.

The land and water are distributed in the respective zones as exhibited in the following tables. It may be, however, noticed before examining the tables, that the two polar extremities, as far as known, present a remarkable contrast; the northern is enveloped by land, the southern, with little exception, by water.

No. 1.

Table of the Area of the Southern, Indian, and Pacific Oceans, taken together.

	Square Miles.
Southern and Pacific Oceans included	100,000,000
Indian Ocean between 40° and 60° S. lat.	7,880,000
Do. from 30° to 40°	4,300,000
Do. do. 20° to 30°	3,200,000
Do. do. 10° to 20°	3,700,000
Do. do. 10° S. lat. to 10° N. lat.	5,200,000
Northern extension of the Indian Ocean, with the Red Sea, and Persian Gulf	1,152,000
Bay of Bengal	613,000
	126,045,000

No. 2.

Table of the Atlantic Ocean and connected Seas.

	Square Miles.
Atlantic Ocean from S. lat. 55° to 40°	1,604,000
Do. do. 40° -- 30°	2,700,000
Do. do. 30° -- 20°	2,600,000
Do. do. 20° -- 10°	2,304,000
Atlantic Ocean between Cape Palmas in Africa, and Cape St. Roque in South America, S. lat. 10°	2,500,000
Atlantic Ocean from a line drawn from Cape Palmas to Cape St. Roque and N. lat. 10°	2,500,000
Atlantic Ocean between N. lat. 10° and 20°	3,225,000
Do. do. 20° — 30°	3,441,000
Do. do. 30° — 40°	2,735,000
Do. do. 40° — 50°	2,030,000
Do. do. 50° — 60°	1,505,000
Do. do. N. lat. 60.	1,616,000
Mediterranean and Black Seas	735,000
Baltic and its Gulfs	92,000
Hudson's Bay	250,000
Arctic Ocean	4,000,000
	33,837,000

No. 3.

Summary of Oceanic Area.

	Square Miles.
Contained in No. 1.	126,045,000
Contained in No. 2.	33,837,000
To these aggregates, add for the Caspian, great Lakes of America, and other smaller collections of water	250,000
Amount of water surface	160,132,000

No. 4.

Land Area.

	Square Miles.
Polynesia, or Oceanica	100,000
Austral Asia	3,000,000
Asia	11,500,000
Europe	3,020,000
Africa	8,000,000
America, Greenland, &c.	13,220,000
Amount of land area	38,840,000

No. 5.

Summary of Land and Water.

	Square Miles.
Water contained in No. 3.	160,132,000
Land contained in No. 4.	38,840,000
Amount of the area of the Earth	198,972,000

From the preceding elements it is seen, that the land surface does not amount to *one-fourth* part of the entire superficies of the earth. The subjoined tables exhibit the relative distribution of the land and water, as respects the astronomical subdivision of the earth into zones:—

No. 6.

Torrid Zone contains Land in

	Square Miles.
Asia	3,000,000
Austral Asia	1,000,000
Polynesia, or Oceanica	100,000
Africa	5,000,000
South and North America	4,500,000
Amount of land within the Torrid Zone	13,600,000

No. 7.

The Land Area of the Southern Temperate Zone.

	Square Miles.
Austral Asia	1,400,000
Africa	640,000
South America	1,520,000
Amount in the Southern Temperate Zone	3,560,000

No. 8.

Land Area in the Northern Temperate Zone.

	Square Miles.
Asia	7,600,000
Europe	3,020,000
North America, Greenland, &c.	5,000,000
Africa	2,360,000
Amount in the Northern Temperate Zone	17,960,000

No. 9.

Land Area in the Northern Polar Circle.

	Square Miles.
Asia	900,000
Europe	20,000
North America, Greenland, &c.	2,600,000
Amount of land in the Northern Polar Circle	3,520,000

No. 10.

	Square Miles.
Land area in the Southern Polar Circle	200,000

The preceding tables are extracted from Darby's "View of the United States," an instructive geographical and statistical work, published at Philadelphia last year. I transmit them to the "Mechanics' Magazine," because they seem to be drawn together with great accuracy; and because they serve to correct an error into which most of our writers on geography have fallen as to the proportions of land and water. The land surface has been usually, I believe, thought to be about *one-third* of that of the water: if these tables are correct, the land surface is, as above specified, less than a *fourth*.

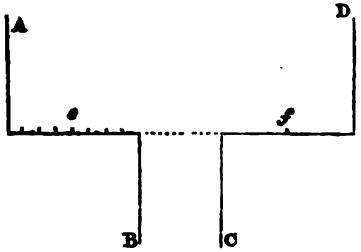
E. L. D.

NOTES ON DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

(*Continued from page* 190.)

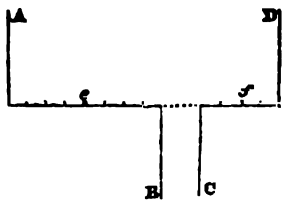
A French philosopher (Poinset) has discovered a certain property which he affirms to be the basis of the whole science of equilibrium. His doctrine is this—two equal weights acting in opposite directions he calls a couple; and one property is, that nothing will balance a couple but a couple.

Fig. 1.



To explain this, let there be two equal forces, A and B, fig. 1. each equal to 16, acting in opposite but parallel directions, at a distance of 8 inches from each other. Now it is evident that the motion so produced would be a rotative *one; or,* in other words, it would spin round a point, supposed to be at *e*, midway between A and B. But let there be another couple of forces of the same weights (acting at the same distance from each other) as A and B, but in opposite directions; it is plain that they would also spin round a point, *f*, but in an opposite manner to A and B: therefore the two couples would be in equilibrium. Consequently, it may be assigned as a rule, that if two similar couples of forces act at equal distances, and tend to produce rotation in different directions, they will be in equilibrium.

Fig. 2.



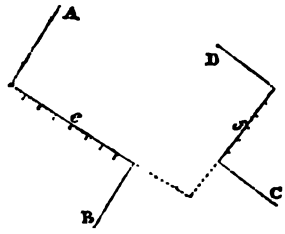
Again, it is not necessary that the distances be equal: for let A and B (fig. 2.) be the same couple of forces as before; but instead of the other couple, C and D, being equal to A

and B, let them be 32 lbs. each, and acting at a distance of 4 inches from each other. Now the rotative effect, which is produced by A and B, will be equal to their weight multiplied by the distance between them, or $16\times8=128$, and that produced by C and D will be $32\times4=128$. But their effects are equal; consequently they neutralize each other's effects, and are in equilibrium. Whence is deduced this rule.—"If the effect produced by one couple of forces be equal to that produced by another, they will be in equilibrium."

It is beautiful to see in this rule the wonderful harmony with which all these different combinations agree, there being still the same manner observed of multiplying the weight by the distance.

In the last cases the forces have been all considered as parallel, whereas the same rules will hold good if the parallelism be not preserved.

Fig. 3.



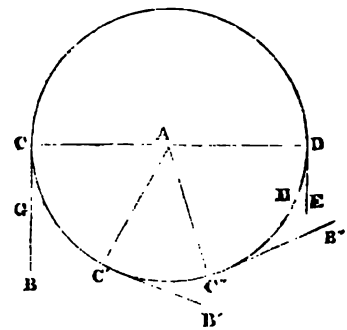
Let A and B (fig. 3.) be one couple of forces of 9 lbs. weight each, acting in opposite directions, at the distance of 8 inches, and let C and D be another couple acting in opposite directions, but not parallel to the former couple, and at the distance of 6 inches, with two weights of 12 lbs. each. Yet these forces will be in equilibrium, if the momentum of the couples be equal; and they are so, because $9\times8=72$, and also $12\times6=72$.

Again, it is not necessary that they be on the same plane, provided the different planes are parallel to each other, although this can only be shown by experiment.

In the last cases the body on which the forces acted was supposed to be perfectly inflexible, but which is never *the case, as no* such body exists. But *such is the imperfection* of science, that the preceding rules must be founded on actual fictions, or on the supposition that there exists a body which has *no* existence: consequently, there is another set of rules to be learnt, and which are called corrections, which are compensations for the fictions obliged to be used in the last case.

It now remains to be considered, what will be the effect produced on a solid by several forces acting together in different directions: it may be supposed to be moveable on a single point (round a centre), or on a line (round an axis). When it is moveable on a centre, the single force to keep it in equilibrium has been shown: therefore, it is only required to find the effect produced when moveable on an axis. The most simple example of this case may be shown in a wheel.

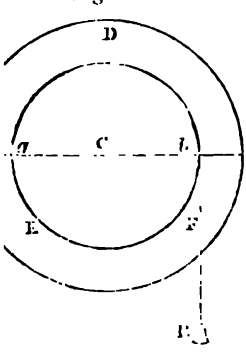
Fig. 4.



Let A be the fixed axis (incapable of any motion) of a wheel, FGH; and let B be any weight acting on the point C, in the direction CB. Now it is evident that if the wheel be turned, the weight will then be exerted on the point C', in the direction of C'B'; and if again turned, it will act on the point C'', in the direction of C''B'': therefore it does not signify in what directions the forces act, so long as they tend to force the wheel round the same way; consequently, its equilibrium cannot depend on the direction alone. Now suppose a weight E to be applied on the point D, in the direction of DE. If this weight E be equal to the other one B, the wheel will be in equilibrium; for the tendency which one

roduce rotation in one direc-
l be counterbalanced by the
e; but if the weights be un-
will be in equilibrium if one
e in inverse proportion to the
their distances from the cen-
has been proved that two
weights, when acting at dis-
this proportion, will be equal
to a weight equal to their
ing on this point; conse-
these weights will not pro-
ation, they will only press on
of the wheel, and that with a
al to the sum of the weights.
ilibrium will not, therefore,
either on the forces or the di-
alone—but on what does it
The rule is this—"Multiply
ight separately, by the dis-
the points on which they act,
centre, and if the products
l the wheel will be at rest."

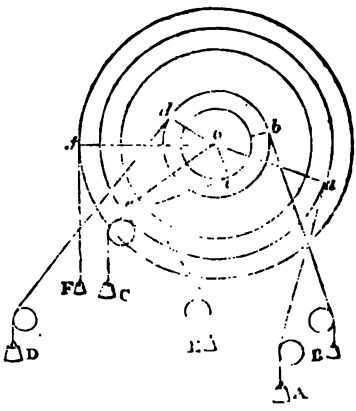
Fig. 5.



(fig. 5.) be the centre of a circle
, and let A and B be two un-
eights acting on points at the
s of *a* and *b* from C. Now if
, the wheel will be at rest.
:8 and B=12, and the dis-
=9 and *b*=6; but 9×8=
therefore the wheel will be
rest by the unequal forces A

next case is, supposing that
forces acting in different di-
tend to produce rotation in
ways; required the condi-
equilibrium. The rule is—
ly each weight by the distance
centre of the point on which
and if the sum of the products
forces *tending to produce* ro-
tation in one way, be equal to the sum of the products of the other forces, then the wheel will be at rest."

Fig. 6.



Let O (fig. 6.) be the centre of a circle, G, H, I; and let A, B and C be three weights acting in one direction, and D, E and F be three weights in another direction, and let them act at the several distances from the centre of *a*, *b*, *c*, *d*, *e*, and *f*. Then if $Aa+Bb+Cc=Dd+Ee+Ff$, the wheel will be in equilibrium. Suppose the weights to be A=3, B=6, C=8, D=5, E=4, and F=2, and the distances to be *a*=7, *b*=3, *c*=2, *d*=3, *e*=6, and *f*=8, then the several products will be,

3×7=21	and 5×3=15
6×3=18	— 4×6=24
8×2=16	— 2×8=16
55	55

which are equal; consequently the wheel is kept in equilibrium, by the unequal forces A, B, C, D, E, and F.

(To be continued.)

PROGRESS OF THE RAILWAY SYSTEM.

(From the Liverpool Albion of Monday.)

"RAIL-ROADS.—Our paper of this day contains numerous notices of the intention of parties to apply to Parliament for acts empowering them to construct rail-roads. Most of these roads will communicate with the Liverpool and Manchester Rail-road, the success of which is now certain, inasmuch as it will be

the grand centre to which all the other rail-roads will tend. The Directors of the Liverpool and Manchester Railway Company have commenced the construction of warehouses two or three stories high, over the road at the west end of the Tunnel, next to Wapping; but it is evident, that the space at present in the possession of the Company, between Crosbie and Sparling streets, will be far too narrow for the accommodation of the parties who will carry merchandise, coal, &c. on the rail-road. We should not be surprised, if, when the line is completed, and the business of carrying has actually commenced, the offices, yards, warehouses, coal depots, &c. should occupy all the ground on the north side of Crosbie-street, from the mouth of the Tunnel to the back of the houses in Sparling-street, and so down to Wapping. We hear that the Directors hope to commence carrying, on part of the line, early in the next year. Coal, from the collieries of St. Helen's, Prescot, &c. will be the first article that may be expected to be brought from Liverpool on the rail-road."

The "Notices" mentioned in the preceding quotation are, 1. For the Wigan Railway, mentioned in our 325th No. and of which Mr. Vignolles is engineer. 2. For "a railway and branches from the collieries at St. Helen's and its vicinity, having a communication with the main line of the Liverpool and Manchester Railway, but also proceeding across the same, and terminating at Runcorn Gap;" of which line Mr. E. Vignolles has been also appointed engineer. And, 3. for "a railway from the Warrington and Newton Railway, to the Grand Trunk Canal, at or near Roughwood Salt Works; with a branch railway from the same to the town of Middlewich."

The eagerness with which these speculations have been embarked in, may be judged of from the following paragraph, which we insert from the same paper:—

ST. HELEN'S AND RUNCORN RAILROAD.—On Tuesday last, a meeting was held at Warrington, for the purpose of engaging shares in the St. Helen's and Runcorn Railway. We understand, such was the anxiety of gentlemen to have shares, that they were literally scrambling over each other's shoulders to get to sign their names; if there had been a present of 100*l.* for each signature, the struggle could not have been greater. *One gentleman*, who could not get directly to the table, went on his knees, crept through another gentleman's legs, and signed in that position, his hand and nose being all that could be observed!

MINOR CORRESPONDENCE.

Glazing Coarse Pottery.—Sir, Being a reader and constant subscriber of your valuable magazine, I take the liberty of requesting you will inform me the title of any work giving information on the best mode of glazing coarse pottery. I am particularly desirous of producing a good black, and also a lead colour; and should be much obliged by any information on the subject, also as to the kind of kiln best adapted for burning pottery.

I am, Sir, your very obedient servant,
Liverpool. F. F. O. B.

[We believe F. F. O. B. will find in Parkes's Chemical Essays all that books can tell him of the potter's art. But probably some of our Staffordshire readers will have the goodness to take the wants of our Liverpool correspondent into their friendly consideration, and favour us with a communication on the subject.—EDIT.]

INTERIM NOTICES.

We need make no apology for giving a precedence to the Almanacs over other matters of older date, yet of a less pressing character. They form the most useful portion by far of our annual literature, and are more extensively circulated than almost any other class of publications. Every one has need of an Almanac; and every one must therefore be anxious to know, as soon as possible, which of the many rivals for his favour is most likely to suit him best.

That we may be the better able, however, to complete our notice of these Annuals, and to do justice, at the same time, to the numerous other claims on our attention, we propose next week to publish a double number. But by way of compensating our readers for the extra expense to which they will be thus subjected, we shall take the opportunity of making them a present of an engraving, on a separate sheet, of the "Rocket," "Novelty," and "Sans Pareil," steam-carriages; very beautifully executed on stone by Burton, drawn to the same scale, and with somewhat greater correctness, than our earlier wood-cut sketches. The double number and the engraving, stitched together in a cover, will cost but 6*d*; the engraving, by itself, will be afterwards sold for 1*s*. 6*d*. As but a limited number of the *engaving* can be printed, early orders will be necessary.

We have received Mr. Gray's papers, and shall not fail to do him the justice he claims at our hands.

G. A. E. is among our papers for insertion.

"Betty's" humorous Epistle to Mr. Hebert only reached us on Thursday night.

Communications received from G. S.—Mr. Daniel—Inquisitor—Mr. K. Williams—Mr. Day—Nemo—Blackstone—Ignoramus—Juvenis Mechanicus—C. J.—T. P. M.—Mr. Times—G. J. Y.—Lieut. Brown—W. H. D.—Mr. Hopwood.

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M. SALMON, Printer, Fleet-street.

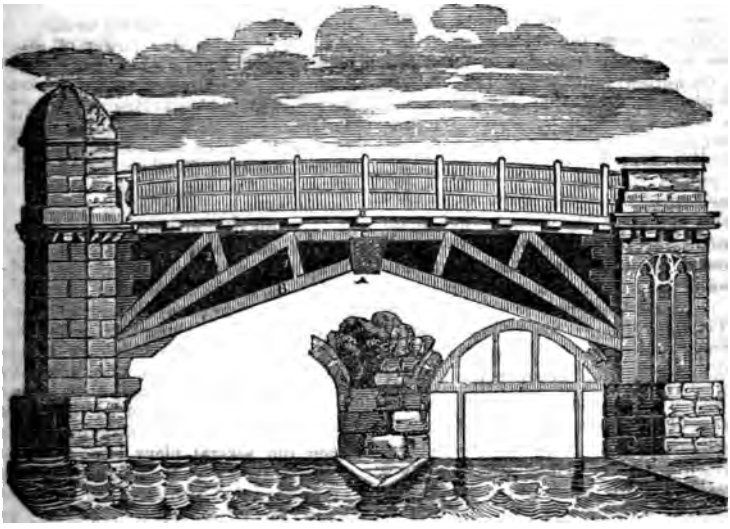
Mechanics' Magazine,

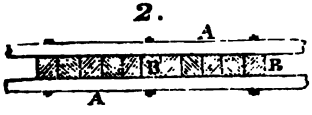
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

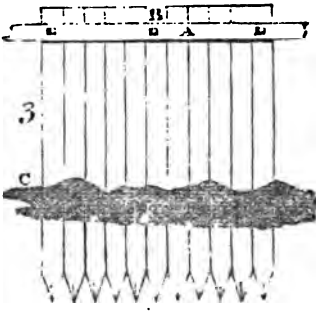
No. 329.] SATURDAY, NOVEMBER 28, 1829. [Price 6d.

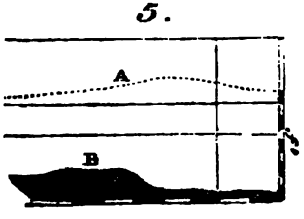
MODE OF THROWING TWO ARCHES OF THE OLD LONDON BRIDGE INTO ONE.

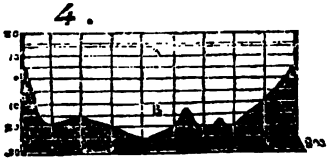
Fig. 1.











A DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE THAMES. BY MR. C. DAVY, ARCHITECT.

No. 4.

Preparations for building New London Bridge — Mode of throwing two Arches into one, &c.

(*Continued from p.* 100.)

From the following statements, it will be seen that Mr. Gwilt augured rather too favourably of the House of Commons, when he rejoiced in the "control over the rebuilding of the bridge" being transferred from the Corporation of London to a Select Committee of that House. The first step of that Committee was to award to the plans of three gentlemen the three premiums advertised by the City, but to adopt none of them! The reason alleged was, that upon farther examination they were all found to be inadequate to the proposed situation; and ultimately, certain plans, designed to order by the late John Rennie, Esq., were adopted. Although it is well known that public competition has never been at any time of the purest description; yet circumstances so extraordinary have hitherto had no parallel in the annals of competition. To substantiate these assertions, we need but refer to the Report presented by the Committee to the Court of Common Council, bearing date October 31, 1828, which runs thus:—

"We, whose names are hereunto subscribed, your Committee for carrying into execution the Act of Parliament for the rebuilding of London Bridge, and for improving and making suitable approaches thereto, who were, by a resolution or order of this Honourable Court of the 21st day of August last, directed to report on the progress, present state, and plans proposed for the completion of the new bridge, and its approaches, and on the actual and proposed expenditure, and to whom it had been previously referred, to consider the allegations in the several memorials of Mr. George Allen and Mr. Peter Jeffery, and also of the inhabitants of the wards of Bridge and Billingsgate, and the petition of the proprietors of stage-coaches running to Gracechurch-street, *from a number* of places within and without the Bills of Mortality, relative to the proposed approaches to the new bridge, Do certify, that upon this Honourable Court being pleased to refer the execution of the said Act to us, we proceeded to take into consideration the model and plans of the bridge designed by the late John Rennie, Esq., *prescribed by the Act*; and it appearing to us, that the erection of a bridge of such an altitude would ultimately occasion a much larger expense than was contemplated in the means which had been provided; and the Lords' Commissioners of His Majesty's Treasury having, according to the provisions of the said Act, alone the power of sanctioning any alteration in such model and plans: we directed another plan to be prepared, which having reference to the means provided, it would be advisable to submit to the consideration of their Lordships, together with the plan of the late Mr. Rennie. And such plan having been prepared, whereby a saving of upwards of 100,000*l.* in the formation of the necessary approaches might be effected, we appointed a Select Committee to confer with their Lordships thereon, and to state the reasons which induced us to produce such additional plan. After which conference it was communicated to your Committee by their Lordships' Secretary, that having heard the reasons stated by the Select Committee, and received explanations upon the several plans and estimates submitted to them, their Lordships were of opinion that there was no sufficient reason to depart from the original plan of a bridge with 5 arches, designed by the late Mr. Rennie, as exhibited by the Committee of the House of Commons, and deposited at the Office of Works, Guildhall," &c. &c.

The principal writers on bridge-building, viz. Gautier, Hutton, Riou, Peyronet, &c., have all proceeded in nearly the same steps in giving instructions as to the commencement of undertakings of this description. The substance of these instructions I shall here give in a condensed form. The proposed situation having been determined, an accurate survey and levels of the opposite shores must be made; soundings taken across the river in a direct line for the purpose of making a section of its bed (as in figs. 4 and 5, which are sections above bridge); the rapidity of the current, and the highest and lowest tides ascertained; and the nature of the soil carefully

iutely examined. These es-
natters being disposed of, the
l number of the arches and
the next things to be attend-
In the design for a bridge not
n 5 drawings are necessary,
dent of minor details. The
l drawings are as follows:—
n of the piers and abutments
west part of the foundation;
superstructure, or roadway;
longitudinal and transverse
; and 5. a general elevation.
e treating of these things, in-
ntly of each other, I shall
ce a peculiar feature in the
practice of bridge-building,
the erection of a chapel in
re of the bridge. I believe it
y generally known, that the
these bridges devolved on the
whence they derived the hono-
e of "Pontifices."* Priestly
e is strikingly apparent in the
of many of the most ancient
structures; in the old trian-
ridge at Croyland, for exam-
ich was made to assume that
honour of the Trinity.† Mr.
moor, in his "History of
Bridge," edit. 1738, has thus
ed to account for the "grand
n which the chapel that for-
occupied the centre of the
was erected:—"To be a
ig for the whole machine, in-
making an angle, as it is in
ous bridge of Prague, and in
the bridges in France, so this
was placed in the middle of
ge to stem the violence of the
ice, and all other accidents
ight be forced against it."
ea of creating a stoppage in
tre of the current of a large
r the purpose of giving addi-
bability to a bridge, is certainly
al enough. Is it not more
his pier was erected in the
f the river for the purpose of
g the bridge in two distinct
r the sake of greater security
ne work was in progress?
I now return to the important
ration of the preparatory mea-
sures for the progress of bridge-works. In the same manner as station-poles are fixed for the line of a new street, so should piles be driven into the bed of the river, and along the intended line forming the centre line of the new works. Along this line and between the piles, soundings are taken as often as the necessity of the work may require, and the boring-machine is as frequently used to discover the nature of the soil. If this is concluded in a satisfactory manner, the foundations of the piers may be then commenced. The reader has been informed of the method employed for this purpose in some of the most ancient stone bridges, called building on stilts: a full account of this method is also given by Scamozzi. Several other means have been at different times employed for this purpose: such as having the foundation erected upon rafts of sound timber of heavy scantling, and allowing it to be gradually sunk at the intended spot, properly guided by ropes, &c.; or by turning the course of the river, thereby leaving the bed perfectly dry; or, lastly, by the improved methods of founding in caissons or coffer-dams. Westminster and Blackfriars Bridges are instances of the caisson method; Waterloo and new London Bridges of the coffer-dam. As these edifices fully exhibit the progressive increase in the size of stone arches—in fact, from those of moderate dimensions to the largest stone arch in existence—I shall be the more circumstantial in describing the modes of their construction.—A coffer-dam is a space in a river surrounded by large pieces of timber of a certain form, called piles, placed or driven close together by a steam-engine, or any other adequate power. The water is withdrawn from between the surrounded space, in order that the pier may be erected on dry ground. *Piling* is of various denominations: close-pileing (for embankments), ground-pileing, plank-pileing, &c. are the terms and varieties in common use. The close-pileing (see figs. 2 and 3) is executed by driving two piles at a distance apart; and these are connected together by bolting pieces of timber to them longitudinally, technically termed wailing-

s buildings were afterwards in the care
perors, and it was also considered an
rity and piety to build a bridge.
m's Arch. Antiq. of England, vol. iv.

pieces. Grooved and plank-pileing is executed by grooving the piles, and introducing a plank of timber into the grooves—thus:

This method gives great neatness to the dam, and generally supersedes the necessity of puddling with clay; it is not, however, remarkable for security. The lower ends of all piles are sharpened or cut into a pyramidal form, and shod with iron; the upper extremities are encompassed with a ring of the same metal, to prevent their splitting by the force of the iron ram with which they are driven into the earth. As soon as the pier is completed, these piles forming the dam are withdrawn. The timber generally employed is either oak, elm, or beech. The coffer-dams of new London Bridge were of an elliptical form, and consisted of three rows of piles dressed in the joints (without grooving): some of them measured between 80 and 90 feet; and they were all puddled with clay, &c. and shod with iron.

The foundations of the piers are raised upon piles of beech wood, on the heads of which were laid two rows of sleepers, 12 × 12, covered with level planking, six inches thick.

In order to compensate for the additional obstruction which the works of the new bridge, while in the progress of erection, would occasion to the navigation of the river, it was determined that, previously to proceeding therewith, two of the small arches of the old bridge on each side should be thrown into one, by which means freer scope would be given to the current. In the accomplishment of a conversion of this kind, more skill is required than might at first sight be supposed. It became necessary for the purpose to board in and take up half the roadway at a time, and to clear away for the reception of an iron girder A, (fig. 1) and massive timber principals B B; also to place what may not be inaptly termed the *brest-summer* C. The principals *have a purchase* on the girder, as may be seen from the engraving; and, instead of being placed at intervals, as in roofs, they are all fixed and bolted *close together* from one end of the roadway to the other, forming a complete unbroken mass of timber. On the brest-summer, at intervals, pieces of timber are mortised in forming joists, or purloins D D D, on which substantial planking is fixed, the road being paved as before. These are further strengthened by counter-principals; some of the struts being fixed close together, and others having an interval of one width between them. It will be seen that the greatest precaution was necessary in the construction, owing to the bulky and weighty materials continually passing over the bridge from the hop-market, tanners, and merchants' wharfs, which are situated contiguous to the building. Another difficulty laboured under was to keep the truss sufficiently high to allow of vessels to pass under; in doing this, the span became exceedingly flat, and added to the difficulty of forming the centering. On the whole, this may be reckoned a good specimen of professional and mechanical skill.

The contractors for the execution of these alterations in the old bridge, and for the building of the new bridge, were Messrs. Joliffe and Banks. For the former they were to receive 30,000*l.*; for the latter, 426,000*l.* The time allowed was six years.

On the 27th of April, 1825, the first coffer-dam above described was finished, and the water pumped out; and on the 15th of June following, the first stone was laid by the then lord mayor, Alderman John Garratt. The *depositum* plate, which was of brass, had the following inscription engraved upon it in Latin and in English. I shall conclude the present paper by subjoining the latter. It is from the pen of Dr. Coplestone, Bishop of Llandaff and Dean of St. Paul's.

THE INSCRIPTION.

"The free course of the river being obstructed by the numerous piers of the ancient bridge, and the passage of boats and vessels through the narrow channels being often attended with danger and loss of life, by reason of the force and rapidity of the current, the CITY OF

ON, desirous of providing a re-
or this evil, and at the same time
ing the convenience of commerce
vast emporium of all nations,
the sanction and with the liberal
Parliament, resolved to erect a
upon the foundation altogether
ith arches of a wider span, and
character corresponding to the
and importance of this royal
or does any other time seem to
re suitable for such an under-
than when, in a period of uni-
peace, THE BRITISH EMPIRE
ing in glory, wealth, population,
mestic union, is governed by a
, the patron and encourager of
nder whose auspices the metro-
as been daily advancing in ele-
and splendour. The first stone
work was laid by JOHN GAR-
, Esq. Lord Mayor, on the 15th
June, in the sixth year of KING
GE THE FOURTH, and in
ar of our Lord 1825; JOHN
IE, F.R.S. Architect."

ION AND JAMES'S LOCOMOTIVE CARRIAGE.

—The want of sufficient time has
o prevented my calling your at-
to some little errors, into which
ve inadvertently fallen, in your
t of Messrs. Sir James Anderson
7. H. James's steam-carriage,
probably from the paucity of
ation contained in my descriptive
of that machine. In reference
ndeserved compliment you paid
at the commencement of your
(p. 194), justice also requires of
tate, that I have not been in the
it degree instrumental in the im-
ent of any part of the apparatus
said carriage; but that whatever
it may possess, in the present
ment of its parts, will be found
specification of the original
granted to Mr. W. H. James,
ears 1824 and 1825.

our comments upon my account
arriage given in the "Register,"
at with ridicule the assertion that
manage to carry one of the en-
each of my coat-pockets; and
that I ought to have added,
st—the furnace, flue, chimney,
&c. Now, Sir, this is just as
ble, as to require of you, because
y have undertaken to carry a
-coach, to carry a horse also,
ach arm, with all the harness,
this case the coach is the ma-
and the horses the power, just
as in the other case of the
engine and the boiler. But if we admit your argument to be correct, you ought to be loaded with eight horses; since the boiler in Messrs. Anderson and James's carriage, which you are desirous of burdening me with, supplies the power to four engines.*

The "*hurdy-gurdy process*," as you facetiously term an early proposition of Mr. James's, for cleaning out the annular chambers of his boilers, I can inform you, is not practised at all; nevertheless it is a very effectual one, and is employed at Birmingham for scouring and brightening various metallic articles. A more convenient and rapidly executed process is now adopted in lieu, which prevents the lodgement of any sediment whatever, and requires only the attention of the engine-man for a few seconds every day; and if neglected for a long period, so as to allow the formation of a hard encrustation, it is removed by a similar process, almost instantaneously, without labour, and without the employment of any chemical agent. For the present, I believe, it is not intended to make the process public.

In my remarks upon the velocities attainable by the carriage of Messrs. Anderson and James, you seem to consider that I have contradicted myself, and request an explanation, which I take pleasure in affording. In saying that arrangements had been made for increasing the speed beyond 12 miles an hour, I had reference to the application of "fast-gear." The "slow-gear" having been proved adequate to propel the carriage at the rate of twelve miles an hour, and the "fast-gear" being adapted to communicate 3½ times the speed of the slow to the running wheels, it was quite correct to state that "arrangements had been made to increase the speed to twenty or more miles," although it was not deemed advisable to use it "on the *thronged* public roads."

With respect to a blast, I think, Sir, you will find that I have not said it was "both necessary and unnecessary," but the latter only.—That although great effects might be produced by it, it was inexpedient, on account of its pernicious effects upon the metal of the boilers.

You express a doubt of the constant effect of the boilers on the plan of those in question, which may at once be removed by your visiting† Messrs. Ander-

* We miss the analogy entirely—if there is any—and must refer the reader again to what we have said on the subject.—ED. M. M.

† We shall take an early opportunity of doing so, and shall report the result to our readers.—ED. M. M.

son and James's manufactory, at Vauxhall; where, I make no doubt, the proprietors will take pleasure in showing you their engine, which has been constantly at work, twelve hours per day, ever since the manufactory was established. They have also recently started a small steam-boat, propelled by machinery and boilers on the same principle, in which I recently made a voyage to Richmond and back (27 miles altogether), in 4 hours and 5 minutes; 19 miles of which was against the current. This is quite as fast as any of the Richmond boats, if not faster; and it was performed under the unfavourable circumstance of the paddles being much too deep in the water; and when you are informed that the radius of the wheel was then less than three feet, you will readily conceive how disadvantageously the paddles must have worked. The boat is unquestionably the *safest* on the river; and when her paddles are altered, so as to waste less of the power, I confidently anticipate she will be also the quickest.

I remain, Sir, respectfully,
Your obedient servant,
L. HEBERT.

20, *Paternoster-row*,
Nov. 21, 1829.

BRAITHWAITE AND ERICSSON'S BOILER.

Sir,—Mr. Braithwaite's last letter, although elegantly written, contains so little substance of a tangible nature, that a very brief reply to it will suffice.

I am accused therein of *disingenuousness*, for *admitting* (as he states) that it was the *flue of the furnace* which gave way, and not the *boiler*. Now, as Mr. Braithwaite has over and over again insisted that that was the true nature of the occurrence, he ought to have charged me with *ingenuousness* for admitting it. It being however recorded in your pages that so far from admitting any such thing, I re-asserted (and in my own judgment *proved* clearly) the contrary: *to whom*, I would ask, in the name of common sense, does the charge of *disingenuousness* apply?

I remain, Sir, respectfully,
Your obedient servant,
L. HEBERT.

20, Paternoster-row,
Nov. 23, 1829.

REPLY OF "F." TO MR. HEBERT.

Sir, — Had Mr. Hebert himself treated the question of the merits of Messrs. Braithwaite and Ericsson's boiler "scientifically," as he wishes me to do, I should never have interfered in the matter. I am no man of science, only a friend to truth and fair play; in which character, and no other, I have presumed to use a bye-stander's privilege. Mr. Hebert says the question is "simply one of science." I submit, that it is simply and exclusively *one of fact*. The Editor of the "Register of Arts" has asserted and re-asserted, that the yielding of the furnace-flue of "The Novelty" was owing to the application of a blast to the furnace; the Editor of the "Mechanics' Magazine" has certified, that the real cause was the want of a sufficient supply of water to keep that flue covered. The question then shortly is, which are we to believe? Mr. Hebert, who was not present at the late competition, who has never seen the engine in question, and who can, for both these reasons, know personally nothing of the matter?—Or Mr. Robertson, who was on the spot at the time of the accident, who personally investigated the cause of it, and who has stated nothing concerning it but as of his own knowledge? We want no lights from *science* to enable us to determine on which side the truth in this case lies. A very small share of common penetration is all that is requisite to lead every one to the same conclusion. Neither do we want any help from science to unmask the purpose which is to be served by Mr. Hebert's invented version of the affair. By persisting in the assertion that the blast was the cause of the accident, Mr. Hebert wishes to make it appear that the principle of the engine was in fault: while, by frankly recognising that the want of water was the cause, he would be forced to acknowledge that the accident was one of the most ordinary description (such as his friend "Betty" must have often encountered in the course of her culinary practice); and one which did not at all affect the principle of the engine, since it would have been equally sure to happen, whether a

blast had been applied or not. Talk, forsooth, of treating the matter *scientifically!* If to substitute fiction for fact, and to persist in thrice-refuted error most pertinaciously, be to treat a matter scientifically, then I will allow—but not till then—that Mr. Hebert has treated the present subject to admiration.

I am, &c., F.

Camden-town, Nov. 23, 1829.

[In a private letter with which we have been favoured from a respectable engineer, the operation of a blast when applied to a steam-engine furnace is so much better explained than it has been yet done by any of the parties to this rather protracted dispute, that though the letter was not intended for publication, we must take leave to quote so much of it as bears on the point in hand. It will, we hope, serve to convince Mr. Hebert, that the reason as well as the truth of the case is on the side of his opponents:—"We usually associate (says the writer) with the word *blast* the idea of a sudden and impetuous gust, operating at intervals, directed to and impinging on some one point: a blast of which description would of course soon destroy the strongest metal subjected to its influence. But this is a term wholly inapplicable to the case of feeding the close fire of a steam-boiler with air: for many times the quantity of air that would pass through a fire by a common draught, may be delivered as softly and regularly by means of a forcing apparatus, and without the least determination towards any one point of the furnace or flue, as if no such apparatus were employed. It is altogether absurd, and contrary to every-day experience, to pretend there can be any danger to apprehend, from any addition which a pair of bellows such as those of 'The Novelty' can make to the volume of air passed through a furnace."—EDIT.]

THE ALMANACS FOR 1830.

(Continued from p. 218.)

THE ENGLISHMAN* appears to us to be *for every body's use* the best of all the almanacs published. Not only does it give a great deal more information in the same space, and for the same money, than any other; but that information is uniformly of a more select, accurate, and generally useful description. We find in it most of what is valuable in the old almanacs, without any of those faults which have been made such grievous matter of charge against them; and much, very much, of the highest value, that is quite new, and to be met with no more else. While "The Englishman" is as free from every taint of "superstition, prejudice, and indecency," as "The British" itself, it is, by we know not how many degrees, more learned and instructive. We have not *here* to lament repetitions on repetitions, or to wonder at blank spaces devoted to the "diffusion" of waste paper; every corner almost is filled with information at once new and useful. The whole, too, is printed in so beautifully distinct and clear a manner, though with types of every variety of minuteness, as to be legible with the greatest ease.

The *Calendar* pages of "The Englishman" exhibit this year an improvement alike remarkable for its novelty and importance. Instead of merely exhibiting the moon's risings for every day from the full moon to the new, and the moon's settings for every day from the new moon to the full, there is now given, for *the first time* in any *English Almanac*, the time of the moon's rising and setting *for every day in the year.*

In order to make room for the two columns containing this new information, an abbreviation of comparatively little consequence has been made in the Tide Table. The time of the *primary* high-water, or that which depends upon the moon's coming to the south, is all that is given; while the *secondary* high-water, or that which depends upon the moon's being on the opposite part of the meridian, is omitted. It is stated, that "the time of the secondary high-water may always be found with sufficient accuracy, by taking the midway between any day's high-water and that of the following day."

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* *We stated last week* that this almanac "owed its existence entirely to the rivalry of 'The British;'" but we have been since assured, on the best authority, that "'The Englishman' was planned before 'The British' was heard of, and would have appeared last year, although 'The British' had never existed."

In the Explanatory Notes subjoined to the Tide Table, a curious fact is mentioned with respect to the difference of high-water *above* and *below* bridge. It is said to be "a well-ascertained fact, that at and near the spring-tides the high-water at Pepper-alley, just above the old bridge, is on the average nearly twenty minutes later than at Coxe's-quay, a little below bridge; the low-water also of spring-tides is about twenty minutes later at Pepper-alley than at Coxe's-quay. The time of high-water is about ten minutes later at Westminster Bridge than just above London Bridge." Is there not reason to apprehend that, when the old bridge is removed, a great alteration will be produced in all these respects?

The column of "Anniversaries" is distinguished, as before, by its giving *all* those Saints' and other remarkable days which are known to the laws and usages of the country: a consistent and, as yet, the only safe course that can be pursued. When, in speaking last week of "The British," we recommended that the *saints* should be uncanonized, we overlooked that the thing has been already very generally done in "The Englishman."

The "Historical Memoranda" are for the most part quite new this year, as compared with those in the preceding almanac. The labour attending the substitution of one set of names and events for another cannot, to be sure, have been great; but, small as it is, there is much in it to commend, compared with the laziness of giving the same series over and over.

The Weather column, or "Table of Meteorological Results," is not, like "The British," applicable to the metropolis, and a small circle around it, alone; but exhibits the mean results of observations taken at Portsmouth, Bedford, Paris, and Maestricht. Last year the mean results were given for London, Dublin, Edinburgh, and Carlisle; and next year we shall doubtless have the fruits of observations made at other places.

Opposite the Calendar page for each month, there are admonitory tables of what is fittest to be done during that month in "Garden and Farm." They seem compiled with care; and we have no doubt will be found of great convenience.

A considerable portion of the same page is devoted to giving, under the head of "Casualties," instructions for *the treatment of* persons apparently *dead from drowning* or other causes, or who have taken any of the known poisons. The introduction of this information forms one of the most novel features of this year's "Englishman," and is unquestionably a great improvement. It is accompanied by a very sensible caution from the editors, which, as it cannot be made too extensively known, we shall here quote.

"We speak," they say, "only the language of professional men eminent for sagacity, learning, and experience, when we say that a very considerable portion of health is destroyed every day in this country by the abuse of the most simple remedies. It is from a conviction of the truth of this assertion, which rests on too many lamentable proofs, that we deprecate the interference of any but medical men in the administration of even the most apparently innocent materials (substances?). Hence, instead of those 'Directions' which some years ago used to occupy so much of almanacs, and which we fear were but too well-calculated to encourage the prevailing vice of domestic empiricism, there will be found a series of simple instructions to be adopted on occasion of accidents, poisoning, and where delay of proper treatment may be attended with loss of life. These instructions will enable any person to interpose, successfully perhaps, between a relative or friend and the grave. *Medical assistance should always be sent for in the first instance*; and during the interval before it arrives, the nearest person should act."

It is due, however, to the "Society for the Diffusion of Useful Knowledge" to state, that the same sort of advice has been given by them in one of their "Companions." Nor can we say it would have lessened the merits of the "Stationers' Company," had they frankly acknowledged that they have, in this instance, but carried into effect a reform recommended by their rivals.

The "Instructions" have been chiefly derived from Orfila, Brodie, and Paris, and appear to be in general extremely discreet. As "The Englishman" may not be seen by every body (though an Everybody's Almanac), we shall extract a leaf from this part, which ought to be hung up over every fireside in the kingdom:—

"Opium, or laudanum, produces stupor, ending in death. First, give five grains of tartar-emetic, in a very small glass of water; and if that does not produce vomiting, give in fifteen minutes about twenty grains of sulphate of zinc, in a glass of water, and irritate the

throat. Remember that the injurious action of opium in the stomach is increased by liquids; therefore you will be sparing of them. You must rouse the patient, and keep him awake by pinching, squeezing, and irritating him. As soon as the stomach is evacuated of the poison, but not till then, you may give lemon-juice, or vinegar and water, also some strong coffee. *Opium is the quacks' sheet-anchor*, and forms the basis of the well-known cough-drops for the cure of colds, asthmas, catarrhs, &c. It is also the chief ingredient in 'Godfrey's Cordial,' which is lamentably popular with nurses. It matters little whether the administration of this 'cordial' to infants in large doses, in order to lull them to sleep, proceeds from ignorance, from good-nature, or from a selfish desire to avoid trouble; the effects are the same. There can be no doubt but that many children are annually cut off, or what is worse, become stupid and ricketty, from the excessive use of 'drops,' under one name or other, which have opium or poppy-juice for their principal ingredient. The influence of opium is so various on different constitutions, that no person should take it for the *first time* without good medical advice. There have been cases where *even four grains* have proved fatal, whilst the same quantity is sometimes taken to produce the salutary consequences which are derivable from this medicine."

"The Englishman's" List of the House of Peers exhibits this year the addition to each name of the date of the person's birth, and a description of his crest—an improvement easily made, and of obvious utility.

Great merit is claimed for an Alphabetical List, *in an abridged manner*, of Counties, Cities, Boroughs, &c. with the names of their respective representatives; but we are dull enough not to perceive where the merit of the *manner* lies. Abridgment of names for any other purpose than that of saving room appears to us to be worse than useless; and in nine cases out of ten, the names in this list are shortened merely to leave a blank space at the end of them. We have, for example, "Dov." for Dover, "Dub." for Dublin, "Leg." for Legge, "Will." for Williams, "Wo." for Wood, "Jon." for Jones, "La." for Lamb, "Pig." for Piggot, "Pr." for Price, &c. while in each instance there is space enough to give the name at full ngth.

It is stated at the end of the list, that "*the House of Commons* begins its sittings at four o'clock in the afternoon, at which moment, if there be not forty members in the House, the Speaker *must* declare it to be adjourned." This is incorrect: the Speaker is only bound to declare an adjournment when a member insists on the House being counted, and there happens not to be forty members present. Nor is the rule limited to the commencement of the proceedings; an adjournment can be enforced on the same ground at any period of the evening.

"The Englishman" is said by its editors to present, "for *the first time in England*, the amount of salaries or parliamentary allowances of the members of the Royal Family, and the various great officers of state, together with the expenses of the chief establishments, civil, judicial, military, naval, &c." We believe this to be only *literally* true. Although this sort of information may not have been before included in any almanac published *in England*, it has been long a prominent feature of the almanacs published *in Scotland*; though not, perhaps, given in any of them so fully as in "The Englishman."

The particulars furnished by this almanac respecting the leading institutions throughout England connected with *education*, is more full and minute, than we have been accustomed to meet with in publications of this description. The following general notice on the subject will be read with interest:—

"Mr. Brougham recently received 500 different returns from different parishes in England and Wales, on the subject of education, from which it appears that there were in these places in the year 1818, 1450 endowed schools, while in 1828 they amounted to 3200. The number of scholars attending these schools was in 1818, 50,000, in 1828, 104,000. The learned gentleman calculates that if the same ratio of increase has gone on in other parts of the kingdom, the number of children attending endowed schools will be found to be upwards of 1,000,000. There are 2000 parishes in England (with however only a population of half a million) which have no schools at all. The establishment of Sunday-schools, to which in a great measure may be assigned (ascribed?) the late rapid extension of education, is attributable to Mr. Raikes, a printer at Gloucester, who at his own expense opened a Sunday-school in that city, in the early part of the year 1782. The system gradually spread through the country, and in September 1785, a

society was formed in London by the exertions of Mr. Fox, a merchant in the city, and the celebrated Jonas Hanway, aided by the active co-operation and advice of Mr. Raikes. At the anniversary meeting of the Sunday School Union Society, held in May 1829, it was reported that there were upwards of one million children in the United Kingdom attending the Sunday-schools."

Among the *Commercial* Lists we observe two new ones of considerable value. One is a List of the Treaties of Reciprocity or Commercial Agreements which have been concluded between Great Britain and other countries—a list which we are glad to observe, already includes the subjects of fifteen different governments. The other is a List of the Warehousing Ports in England, Scotland, and Ireland. A statement is added of the total number of vessels belonging to the ports of each country; it would be better if the number belonging *to each port* could be given.

There are a good many more features of improvement, which might be noticed in "The Englishman;" but as we have still to pay our respects to its new companion, "The Tradesman's and Mechanics' Almanac," and perhaps to some others of the class, we must now draw our notice of it to a close. We may say of it generally with great truth, that in point of quality as well as quantity, it is far better worth every-body's money, than any other almanac in the field.

"The Tradesman's and Mechanics'" we do not like *quite so well*. The following explanation of the circumstances which have led to its appearance is somewhat in an *ad captandum* taste, but it contains a well-merited tribute to the intellectual improvement of the class to whose services it is dedicated.

"The causes which have led to the publication of such a work must be sufficiently obvious to those who have watched the active progress of general society in recent years. They must have perceived that from various quarters a stimulus has been communicated to the minds of that comprehensive class of our countrymen, the members of which were formerly contented to gain distinction merely by their hands—until at last the trading and working population has been reared into a body not to be excelled by any other in the *State for intelligence* and attainment."

The Calendar pages of this almanac are not so well filled as those of "The Englishman," and exhibit omissions for which it is rather difficult to account. They contain nothing about either high-water or the weather, and no historical memoranda whatever. Are we to conclude that in the estimation of the Stationers' Company, tradesmen and mechanics form a class to whom the treasures of history are of no account, and foul and fair weather, high and low water, all the same?

Among the matters *peculiar* to this almanac—peculiar because they are supposed to be more immediately interesting to the trading and mechanical classes, than any others—those which we have observed with most satisfaction, are—a List of the Incorporated Trading Companies of London, including those without Halls and those without Liveries, and specifying when and where they have such business—A List of the Penalties incurrable under the Stamp Act—An Equation Table to regulate the investment of money; showing the value which the public funds and landed estates should bear to each other, to yield the same annual interest (a much more useful table than the one of a similar description in "The British")—An article on Savings' Banks, and another on Friendly Societies (both excellent)—A List of the Public Schools, with the conditions of admission to each—Forms of various Documents, such as bills, receipts, memorandums of agreement, &c.— Directions how to address Persons of all Ranks, (an useful addition to which would be an explanation of the abbreviation of titles in common use,)—And a table headed, "Consumption and Taxes," showing that the weight of the latter falls chiefly on articles consumed by the middle and lower classes of society.

In a note subjoined to the *form of a will*, the writer labours under a great mistake; so at least a friend learned in the law assures us. It is here stated, that "the words *of sound and disposing mind* seem essentially necessary to the validity of wills, and should never be omitted to be noticed and acknowledged." Now, though it is necessary, as every one knows, to the validity of a will that the testator should be of a *sound* and *disposing mind*, yet as a statement to that effect in the will itself is *no evidence* of the fact (for who so mad as to call himself so?) we are informed that it has long been considered by lawyers perfectly nugatory, and is now rarely introduced in practice.

At p. 36, we have a Table for computing *decimally* the daily expense that is equivalent to any given yearly income; and at p. 38, another for computing also *decimally* simple interest at different rates for years and days. We do not know that a greater compliment could be paid to the "trading and working population" than is conveyed by the nature of these tables. How many years may it be since the notion of offering *decimal* tables of any kind for the use of *tradesmen* and *mechanics* would have been laughed at? We cannot, at the same time, award the tables before us our entire approbation. We are of opinion that no decimal tables of simple interest *for years or months*, however carefully calculated, can be of any practical use; because the direct calculation is so simple, that any person who could make use of such tables with due expertness, could perform it more quickly without their aid. The case is different with regard to interest *for days*; and if the Editor had given decimal tables for days, occupying two or three entire pages, they might have been of some practical utility.

The "Tables of Weights and Measures" given at pages 54 and 55, seem to us to be borrowed, without acknowledgment, from the Useful Knowledge Society's "Companion" for 1829, but sadly mutilated and spoiled in the transfer. Had the Editor given the article *entire* as he found it in the "Companion," the adoption of it would have done credit to his judgment; for we believe we shall not exaggerate its merit, when we say that it contains the only systematically arranged set of tables which has hitherto appeared for popular use. It is given *entire* in the "British" for 1830.

The article which follows, entitled "French and English Weights and Measures compared," is derived from a recent report by a Mr. Mathieu to the Society of Agriculture of Paris; but all the information contained in it might have been found much nearer home had the Editor done us the honour to consult our Eighth Volume, where there is a table by our able and esteemed correspondent, Mr. Woollgar, in which all the calculations of Mr. Mathieu are anticipated. As far as regards the *measures*, the two tables agree almost exactly; but with respect to the *weights*, the two computers differ to the extent of a grain in the value of the *gramme*, which of course affects all the other values connected with it. In the present Editor's edition of the tables there are two errors. For 2·473614 acres we should read 2·47114, and for 4·84345794 livres 4·54, &c. The latter is evidently an error of the press.

"Tables of the Coins of Foreign Countries, with the corresponding Values in English," ought naturally to have followed this comparison of the English and French weights and measures; but they are given at the bottom of the calendar pages, where they occupy places that would have been much better filled with matter more appropriate to a calendar.

The table which is given under the head of "State of Trade," on the authority of Alderman Waithman, is very undeserving of the distinction conferred on it. The Editor seems half ashamed of it himself, for he apologises for its insertion by observing that the Alderman's "facts" have been denied—his "inferences" disputed, and that he merely gives it as an "*ingenious* document which may facilitate inquiries into the important matters of which it treats." But considering that this *ingenious* document is, at the same time, notoriously one of the most erroneous ever put forth, we must be permitted to say, that it seems quite as likely to obstruct as to facilitate inquiry; while, in the mean time, it is serving to give currency to all manner of evil impressions with respect to the trade and resources of the country.

The table under the head of "Waste Land" forms another great page of error. It pretends to exhibit the exact number of acres in each county in Great Britain and Ireland, now lying waste, but alleged to be convertible into fine arable fields, gardens, meadows, orchards, &c. The thing had its origin, we believe, with a "Society for the Encouragement of Industry and Reduction of Poor Rates," which meets somewhere in the Poultry, and consists of a Secretary and one or two other old women; and possesses precisely that degree of authority which might be expected from the character of its parentage. Every well-informed and practical man knows, that to talk of there being many millions of acres of land in Great Britain and Ireland *unprofitably* neglected, is pitiable delusion.

Of minor faults, we find a good many in our notes; but shall content ourselves with pointing out one or two that seem most to require correction. The *Stamp* Duties on Probates and Administrations, and on Presentations to Livings—the Excise Duty on Auctions, and (stranger still!) the penalty for

giving false characters with servants—are all given under the head of *Assessed Taxes!*

In estimating the merits of the "Tradesman's and Mechanics' Almanac," it deserves always to be kept in mind, that this is *its first appearance.* Although not now so good as our favourite "The Englishman," it is to be hoped that we shall next year find it contesting the palm of superiority on more equal terms. Of its being a work *wanted* by the class of persons for whose use it is intended, there can, we presume, be no doubt; and both on that account, and on account of the great quantity of useful matter already embodied in it, it is deserving of every encouragement.

(To be concluded in our next.)

THE LATE RAILWAY COMPETITION.

Finding that considerable misapprehension generally prevailed with respect to the comparative dimensions of "The Rocket," "The Novelty," and "The Sans Pareil" steam-carriages, in consequence of our wood sketches of them having been drawn to different scales, we have now had the whole engraved on stone to the same scale, and on one sheet, which accompanies the present Number. We have taken the opportunity of correcting an error in the original sketch of "The Sans Pareil," in which the furnace and tender should have been represented at the end of the engine next the chimney; also some trivial inaccuracies in the other engravings.

RAILWAYS IN IRELAND.

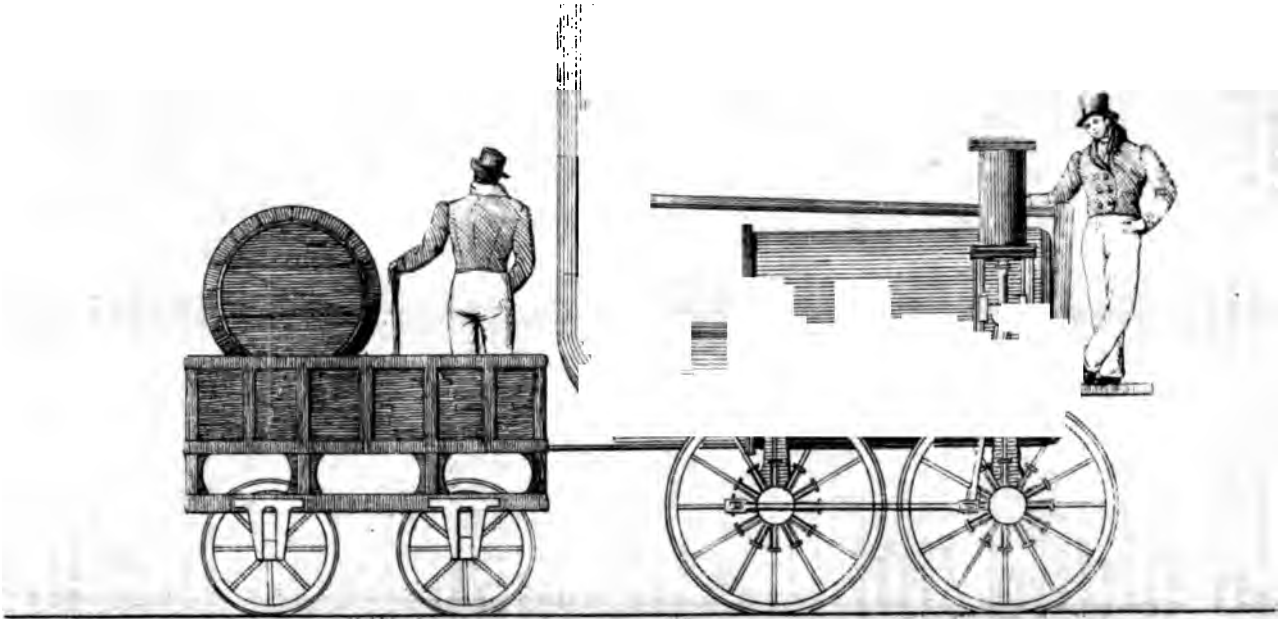
We understand that Mr. Nimmo, the engineer, who has so eminently distinguished himself in connexion with the roads and bridges of Ireland, has surveyed the country between Limerick and Waterford, with the view of laying down a railway between these two important towns.

THE NAUTICAL ALMANAC.

Mr. Editor,—I have for a length of time been much gratified at the *scientific results* elicited in your truly entertaining miscellany; and purpose offering you, from time to time, such nautical and astronomical observations, as a hard course of service for twenty years has enabled me to scrape together—more particularly on tides and currents of the ocean: the digests of which, however, are so much at variance with most or all of our renowned theorists, as theirs have been with common sense, that perhaps they may not be favourably received. My object, however, at present, is to express my regret (as a well-wisher to the circulation of the "Mechanics' Magazine") at the extraordinary assertions of "Orion" in the Magazine for August, 1829. It must, I think, appear evident to all those who are willing to render to Cæsar the things which be Cæsar's, that the naval branch at least of our administration, since 1818, has spared neither pains, expense, nor arrangement, to render every operation under its control connected with maritime affairs, plain, efficacious, and easy of access. That some mistakes have partially intruded themselves into our ephemerides, the constant habit of consulting those books for the last twenty years compels me to admit; but I have seen nothing to warrant "Orion" in his charge of disgraceful notoriety, or indeed any part thereof, which their errata-sheet, or a competent proportion of brains, would not at once elucidate—certainly nothing which could affect materially the position of a cruising ship in the Mediterranean. I pledge myself to refute this anomalous insinuation against the majesty of the "British Almanac," whenever "Orion" will do me the favour to state specifics.

That an English captain (and such a one as Captain Smyth too) should only find his way to England from the Mediterranean, through the fortuitous means of a foreign almanac, or ephemeris, will, I think, appear just as likely, as that a Spanish captain should have suddenly been placed *hors de combat*, through the errors of an English one!

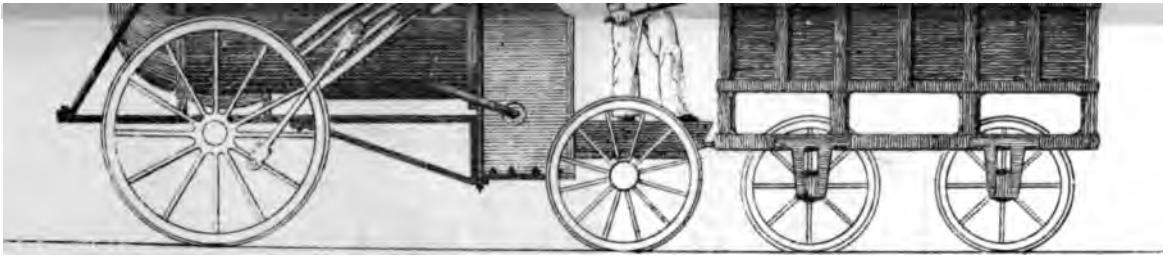
To the opinion of the learned gentleman mentioned in "Orion's" letter I bow with great submission: his ideas are always pithily expressed,



Burton, del.t on Stone.

The **SANS PAREIL** of Mr. Huckworth of Darlington.

Which drawing a load equivalent to three times its weight, travelled at the rate



The ROCKET *of Mr. Robt. Stephenson of Newcastle.*

Which drawing a load equivalent to three times its weight travelled at the rate of 12½ miles an hour, & with a carriage & passengers at the rate of 24 miles. Cost per mile for fuel about three-halfpence.

and none more so than the doctor's former observations upon chronometers; viz. that no time-keeper should be accounted worth any thing which would not bear the undulating motion of a hard trotting-horse!!

Pray, Mr. Editor, give this a place in one of your early numbers, and oblige,

Your obedient servant,

CHRONONHOTONTHOLOGUS.

THE VELOCIPEDE.

Mr. Editor,—If the extent and subject of the following observations do not render them altogether inadmissible to your valuable pages, I shall be obliged by their insertion; and by the reply, no less, of some one of your numerous and intelligent correspondents in a future number.

It has struck me, Sir, as somewhat singular, that one of the most promising inventions of this inventive age, which made its appearance some ten or twelve years back, should, after so short a space of time, have been consigned to the neglect of an obsolete trifle: I allude to the discovery of the *velocipede*, or *pedestrian curricle* (as it was by some designated), whose use, about the time stated, was as common as it was transient. Now, Sir, rumour has stated that this machine was suppressed either by legal or civil authority; but neither judgment nor information have led me to consider this statement as having the shadow of correctness. The invention, in itself, I need scarcely say, is characterised by the greatest simplicity as to principle, economy as to expense, and convenience as to application. It was indeed twofold; but my particular reference is to that modification of it which was put into operation by treadles and cranks, the rider being seated as in a chaise. It is true that to the innkeeper and ostler, the stage-coach proprietor, and some others, the success of this invention would be a matter of odium, as dispensing with the care and keep of the one party, and with the conveyances of the other. It is true, that with men of expensive habits, whose self-satisfaction would be reduced in proportion to their diminution of external show, an engine at once so economical and unobtrusive would find but little patronage. But, Sir, if the system or means of locomotion in question possesses, as it appears to me it does, the qualifications of celerity, lightness, elegance, compactness, durability, and ease of propulsion—if it be opposed by impediments fewer and less worthy of notice than those attendant on any scheme of similar pretensions—if this invention provides individuals with a means of conveyance independent of the casualties and preparations inseparable from the use of vehicles in general—*if*, in fine, *the end of knowledge is practical improvement, in adding to the facilities, comforts, and resources, and consequently to the moral amelioration of the human species*—surely such an invention as that of Mr. —— (I am ashamed to forget his name), is one far less worthy than most, of that oblivion into which it appears to have sunk.

Mr. Editor, I have to beg pardon for thus trespassing upon your attention; but I trust the comparative importance of the subject may plead my excuse. Some may reply, "Set the example, in restoring the use of the machine you recommend;" and the appeal would come with some force were your writer subjected by his avocations to pedestrian exercises. As it is, however, he contents himself with bringing the subject before the more judicious consideration of the readers of the "Mechanics' Magazine;" some of whom, should any queries arise as to the expenses, &c. incidental to the proposed scheme, will be fully able to give a satisfactory reply.

He has the honour to remain,
Mr. Editor,
Your obedient servant,

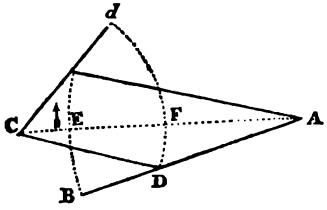
Φιλομηχανος.

Coleman-street, Sept. 24, 1829.

PROPERTIES OF EPICYCLOIDAL TEETH IN CLOCK AND WATCH MACHINERY —HARRISON'S ESCAPEMENT.

Sir,—Mr. Wynn, in No. 283, p. 371, says, "I consider the application of friction-rollers to the pinions which

are driven by wheels with the teeth of the epicycloidal curve, a great absurdity; because one of the principal objects of making the teeth of this curve, is to prevent the rubbing of the surfaces by the rotation of the teeth, which, if the curve be perfectly constructed, will roll through each other without the least friction whatever." Now such an assertion from a person professing to understand machinery, seems unaccountably strange; he must be purblind, indeed, who cannot see the contrary. How is it possible for the teeth of two wheels, those of one wheel pressing against those of the other, and which when in action must move towards and recede from each other's centres of rotation the whole distance they take hold of each other, to be prevented from rubbing? And how, in the name of wonder, can such rubbing be prevented by any particular form being given to the teeth? As the teeth of each wheel and pinion, when in action, do necessarily enter into the spaces between each other's teeth, and come out again; and as they press against each other during this in-and-out motion, it is so very plain that their surfaces do inevitably rub or glide against each other, that it would be obvious to a boy, even during the first month of his apprenticeship to a clock or watch maker. The following diagram, wherein the teeth of two wheels in action are supposed not to be rounded off, may perhaps explain the use of the epicycloidal curve.



AB is the radius of a wheel driving another wheel whose radius is CD. It will appear by inspection, that the end D must move slower than the end B, until both these points arrive at the line of centres in E and F; when in an instant the point of contact being shifted from F to E, the speed of CD must at the same instant be exceedingly increased, AB being supposed to move at a steady rate. Hence, during the time AB makes an equal angle on each side of the line of centres CA, CD makes the very unequal angles DF and F*d*; and the force necessarily varies inversely as the velocity.

To prevent such an irregularity, (which at least must cause a most rapid wear in the teeth, and if the speed and the weight in motion be great, might probably break the machinery,) the ends of the teeth are necessarily rounded off, whereby the transition of the point of contact may proceed gradually from one point to the other, and the speed of the two wheels may thereby be rendered uniform throughout all angles of the teeth; and which is effectually accomplished by rounding them off in true epicycloids. Hence the two wheels moving together the more perfectly equal, and consequently the teeth gliding more smoothly, reduces the friction to the least possible quantity; and it can only be further reduced by the adoption of rollers, to turn as the teeth which press against them enter in and come out.

But Mr. W. suspects that with rollers the force and velocity would not be equally conveyed through all the inclinations of the angle of the teeth. Although he might have satisfied himself respecting this matter from what I said before, yet I have no objection to inform him again that *the rollers being in the circumference of the pinion,* the curve to act against them, to cause a uniform motion, is quite different from that which is required to effect the same purpose in pinions with leaves: in these the curved part of the teeth of both the wheel and pinion acts against the straight part of the teeth of each other within the pitchings, *and which straight part tends direct to the centre.* It is quite as easy, however, to adapt the former true to the rollers, as the latter true to the radii.

As what I said respecting wheels and pinions with few teeth, was only in explanation of the epicycloidal principle, (as your readers may see, from No. 260, p. 2.) it is certain that Mr.

W.'s "spinning a long yarn" to pervert my meaning, might as well have been omitted. On the contrary, I agree with him in the impropriety of making the wheels and pinions of low numbers; but I do not admit that there is any more difficulty in practically producing a large portion of the epicycloid than a small one. It is true, a practitioner not having any knowledge of the true curve, is liable to deviate much more as a greater portion of it is required, which is the case with low numbers; and in which also any want of truth in the execution is much more sensibly felt. Low numbers have also the disadvantage of more friction, by necessarily acting to a greater distance from the line of centres; it is therefore not likely that I should be in favour of low numbers. As to the execution of roller-pinions, I do not find any more difficulty in making them of their true diameters, than those with leaves: there is an easy and sure method of doing them.

Mr. W. informs your readers, that there is no novelty whatever in either of the escapements I have pointed out, for that they were probably used before I was in existence; and of course had he considered them the best, he should have chosen them. As those escapements were not in being before I invented them, and of course could not be in use before the inventor of them was in existence, I could not but be displeased at Mr. W.'s assertion; but on recurring to the description I had given of them, No. 278, p. 290, and No. 281, p. 342, I found the fault was mine. I had mentioned my introducing them into clocks, and I had detailed some of their principles, &c., but, by a strange inadvertence, I had not said I was the inventor; and although this might be implied, it was an omission I did not intend: for as both of them are entirely my own invention, and I consider them to be the most improved clock-escapements that I have ever seen described in any publication, and probably that have ever yet been applied to any clock by any person except myself and son, your readers will easily conceive that I must have designed it to be understood that I was the inventor. One of these escapements Mr. W. has never had the opportunity of seeing; and if he has ever seen the other, it is plain he does not understand it, by his saying "they are very complicated and intricate in their performance." On the contrary, to simplify the machinery through which the impulse is given to the pendulum, is the very object for which they are adapted; and by which the compensation for the different densities of the medium, of which they are also susceptible, is communicated the more uniformly. There is no intricacy in those escapements; neither do I conceive them to be any more liable to derangement than common ones: so that Mr. W.'s long tale about complicated plans, and his own ideas of doing work on such principles as are least susceptible of derangement, &c. &c., might have been spared.

But though Mr. Wynn says there is no novelty in either of my escapements, and although I do not consider novelty or even ingenuity to have the least claim to superiority, unless it be accompanied by improvement; yet I am persuaded that they do really possess novelty also. The demonstration of this, however, and some other particulars, I must reserve for a subsequent communication.

I am, Sir, &c.
JAMES HARRISON.

NAVAL ARCHITECTURE—THE SEPTENARY SYSTEM.

Sir,—Permit me to make the following statement, which, in consequence of the information contained in your quotation from the "Hampshire Telegraph," in No. 325, under the head "Naval Architecture," appears to be necessary.

You know that I have now for more than seven years used every means within my power to impress on the minds of naval architects the conviction which I feel that a knowledge of the septenary system, and those simple means which I have discovered, by which a gradation of lines may be generated, cannot fail to be of great advantage both in the designing and constructing of ships; for a fair gra-

dation will always produce a fair body; and a knowledge of the nature of the curves of which a vessel is formed, must for many reasons be of great utility.

These sentiments I have personally communicated from time to time, not only to Englishmen, but also to many gentlemen from various parts of the Continent, including both the southern and northern parts of Russia; indeed, as far back as the year 1823, Admiral Greig made inquiries respecting my inventions for curves; and I have a perfect recollection of the manner in which a gentleman from Russia expressed his concurrence with the ideas I have so earnestly recommended. But whether any thing I have said has had any tendency to induce persons at so great a distance when making experiments, to construct their ships *by gradations of mathematical lines*, I am not informed; however, from the above it may be inferred that such a circumstance is possible; and should it ultimately appear to have been the case, it will be a remarkable fulfilment of the prediction of a friend, to whom I had said, that foreigners appeared to appreciate my inventions more than individuals at home. The purport of my friend's remark was, that I was not to mind that, for the information would rebound to this country with proofs of utility.

Apart from these considerations, it is gratifying to learn that two frigates, whose vertical and horizontal sections are known mathematical curves, have been constructed. These, whatever their properties may be, which of course it must be interesting to learn, will form valuable data for the naval architect; and will deserve the particular consideration of all those who are desirous to discover the true principles of the art of ship-building.

I am, Sir,

Your obedient servant,

JOSEPH JOPLING.

24, *Somerset-street, Portman-square.*

ON THE PROPERTIES OF THE HEBDOMAD, OR NUMBER SEVEN.

(Concluded from page 159.)

It is also said with respect to the peculiar composition of the hebdomad, as having an admirable order in its nature, since it consists of three and four, that the third number from the monad in a duple ratio is a square; but the fourth number in the same ratio is a cube, and that the seventh is a cube, and at the same time a square.* Hence the seventh number is truly perfective, announcing both qualities, the superficial through a square, according to an alliance with the triad, and the solid through a cube, according to an alliance with the tetrad. But the hebdomad consists of the triad and the tetrad. The hebdomad however, is not only perfective, but, as I may say, is most harmonic; and after a certain manner is the fountain of the most beautiful diagram which comprehends all harmonies, *i. e.* the diatessaron, the diapente, and the diapason; and likewise all analogies; viz. the arithmetical, the geometrical, and besides these, the harmonic. But the *plinthion*† consists of the numbers 6, 8, 9, and 12. And 8 is indeed to 6 in a sesquitertian ratio, according to which the harmony diatessaron subsists; but 9 is to 6 in a sesquialter ratio, according to which the harmony diapente subsists; and 12 is to 6 in a duple ratio, which forms the harmony diapason. It contains likewise, as I have said, all analogies; the arithmetical, in the numbers 6, 9, and 12: for as the middle number surpasses the first by 3, it is also surpassed by the last number by 3; but it contains the geometrical analogy in the four numbers 6, 8, 9, and 12. For as 8 is to

* Thus in the numbers 1, 2, 4, 8, 16, 32, 64, which are in a duple ratio, 4 is a square. 8 is a cube, and 64 is both a square and a cube. Thus also in the numbers 1, 3, 9, 27, 81, 243, 729, which are in a triple ratio, 9 is a square, 27 a cube, and 729 is both a square and a cube. And this will also be the case with numbers in a quadruple, quintuple, &c. ratio.

† See chap. 32 of the 2nd book.

6, so is 12 to 9, the ratio being sesquitertian: and it contains the harmonic analogy in the three numbers 6, 8, and 12. There is, however, a twofold criterion of harmonic analogy; one, when as the last term is to the first, so is the difference between the last and middle, to the difference between the middle and first term. Of this, the most evident verification may be derived from the proposed numbers 6, 8, and 12; for the last is double the first term, and 12 exceeds 8 by 4, and 8 exceeds 6 by 2; but 12:6::4:2. The other criterion, however, of harmonic analogy is, when the middle term by an equal part surpasses, and is surpassed by the extremes: for 8, being the middle term, surpasses the first by a third part of the first term, for 8—6=2, the third part of 6; but it is surpassed by the last term by an equal part of the last, for 12—8=4, which is the third of 12. These things, indeed, necessarily thus subsist with respect to the venerable nature of this diagram, whether it may be proper to call it plinthion, or to give it some other appellation; so many ideas, and still more than these, does the hebdomad exhibit in things incorporeal and intelligible.

But the nature of it likewise extends to every visible essence, pervading through heaven and earth, which are the boundaries of the universe: for what part of the world is there, which is not enamoured of the hebdomad, being tamed by the love and desire of it? They say, accordingly, in the first place, that heaven is begirt with seven circles; the names of which are, the arctic, antarctic, the summer tropic, the winter tropic, the equinoctial, the zodiac, and besides these, the galaxy. For the horizon belongs to us; according to the acuteness of our vision, and the contrary, our sensible perception being circumscribed by it in a greater or less degree. The planets, too, an army proceeding in a course contrary to that of the fixed stars, being arranged in seven orders, exhibit an abundant sympathy with the air and the earth. They vary according to what are called the annual seasons, producing infinite mutations in each of them, by serene and cloudy weather, and by violent storms of wind. Again, they cause rivers to overflow, and to be diminished; plains to become stagnant water, or, on the contrary, to have a squalid appearance. They likewise produce the mutations of the sea, its fluxes and refluxes. For sometimes the gulfs of the sea, when it resounds through its reciprocations, form profound shores; and a little after, the sea returning, becomes deep and navigable, not by bearing small burdens, but an innumerable multitude of large ships. The planets likewise generating all terrestrial animals, plants, and fruits, increase and bring them to perfection, preparing the nature in each to run its course, so that new flowers may succeed the old, and may arrive at their acmé, in order to supply animals that are in want with an exuberant abundance. Moreover, the Bear, which is said to be the precursor of sailors, consists of seven stars, to which pilots looking, cut through ten thousand paths in the sea, attempting a thing incredible, and greater than human judgment could expect to accomplish; for by looking to the above-mentioned stars as leading lights, regions have been discovered unknown before, islands by the inhabitants of continents and continents by islanders: for it was necessary that the profound recesses both of the earth and sea, should be unfolded by the most pure essence of the heavens to the animal which is dear to divinity.

In addition to what has been said, the choir of the pleiades derives its completion from a hebdomad of stars, the risings and occultations of which become the causes of mighty good to all things; for when these set, furrows are cut for the purpose of semination, and when they are about to rise, they become the joyful messengers of harvest: when they rise, they excite the glad husbandmen to the collection of necessary aliment, who well-pleased deposit the food they have collected for diurnal use. The sun, too, the leader of the day, by producing two equinoxes in every spring and in autumn—the vernal in Aries, but the autumnal in Libra—procures the most manifest

credibility of divine majesty about the hebdomad; for each of the equinoxes takes place in the seventh month, at which times the law orders the greatest and most public festivals to be celebrated, since in both these the fruits of the earth arrive at perfection: in spring, corn and other seminations; in autumn, the produce of the vine, and of most other trees. Since also terrestrial are suspended from celestial natures, according to a certain physical sympathy, the productive principle of the hebdomad originating supernally descends as far as to us, that mortal genera may be partakers of its advent.

Our own system also, the ruling part excepted, is divided into seven parts; viz. the five senses, the vocal organ, and the generative power: all which, as in admirable unison, being drawn by the ruling part as if by secret strings, at one time are at rest, and at another time in motion—each according to appropriate habitudes and motions. In a similar manner, likewise, if any one endeavours to explore the internal and external parts of the body, he will find that in each of these there are seven. The parts that are most obvious are these—the head, the breast, the belly, the two hands, and the two feet: but the internal parts, which are called the viscera, are, the stomach, the heart, the lungs, the spleen, the liver, and the two kidneys. Again, the most ruling part in the animal, the head, employs seven most necessary parts, two eyes, an equal number of ears, two nostrils, and, in the seventh place, the mouth, through which, as Plato says, there is an ingress of mortal, but an egress of immortal natures. The meat and drink which enter into it, are the corruptible nutriment of the corruptible body; but from the reason of the immortal soul, there is an egress of immortal laws, through which the rational life is governed. The subjects also of the judicial power of the sight, the most excellent of the senses, participate, according to the genus of the number seven: for there are seven things that are seen, body, space, magnitude, colour, motion, and permanency; and besides these, nothing else. It happens, likewise, that all the mutations of voice are seven; the acute, the grave, the circumflex, the rough, the smooth, the long, and the short sounds.

Moreover, it happens that there are seven motions; the upward, the downward, to the right hand, to the left hand, before, behind, and the circular; all of which become in the highest degree manifest from leaping. It is also said, that the secretions through the body are subject to this number: for offspring that are born in the seventh month live; but those that are born in the eighth month, for the most part, die. Severe diseases of our body, likewise, and especially when from the bad temperature of the corporeal powers we are afflicted with continued fevers, are principally decided on the seventh day: for this day forms a judgment of the contest about the soul—to some decreeing safety, but to others death.

But the power of this number not only extends to the above-mentioned particulars, but also to the noblest of the sciences—to grammar and music. Thus the lyre consists of seven chords, analogous to the choir of the seven planets, produces the most noble harmonies, and is nearly the leader of all instrumental music. Among the elements, too, of the grammatical art, the vowels truly so called are seven, since they are seen to produce a sound for themselves; and when they are conjoined with other letters, they form articulate sounds: thus supplying what is wanting in the semi-vowels, by furnishing entire sounds; while they turn and change the natures of the mutes, by inspiring them with proper power, in order that things which were before ineffable, may become effable. Hence those who first gave names to letters, as being wise men, appear to me to have denominated this number επτα, from the veneration and inherent sanctity pertaining to it (απο του περι αυτον σεβασμου, και της προσουσης σεμνοτητος). But the Romans adding the letter σ, which is wanting in the Greek, more clearly exhibit its origin, by calling it septem; from, as I have said, veneration and sanctity.

Thus far Philo; but farther, according to Herophilus, as we are informed by Theo of Smyrna,* the human intestine is 28 cubits long; *i. e.* four times seven, and 28 is a perfect number: the moon also is said to impart from the ethereal to the sublunary regions celestial powers, while she uses the tetrad and the hebdomad. The increase, likewise, and decrease of things, and especially of such as are humid, follow the phases of the moon. Hence a Greek poet, cited by Baptista Camotius in his Comment on the Metaphysics of Theophrastus, says of the moon, "that when she increases she augments, and when she decreases, injures all things."

This number, too, is the shortest boundary of the birth of children; and, according to the Theban Hephæstion, the longest boundary of the duration in the womb of those children that are born in the tenth month, is 288 days and 8 hours; the mean duration is 273 days and 8 hours; and the shortest duration is 258 days and 8 hours. But of those that are born in the seventh month, the longest duration in the womb is 206 days and 8 hours; the least duration is 176 and 8 hours; and the mean duration is 191 days and 8 hours. The ancient physicians likewise, as we learn from the anonymous writer, observe, that seven hours prior to the birth, the navel of the fœtus is spontaneously separated from the mother, within which space of time the fœtus is able to support life without receiving any nutriment from the mother.†

Again, Plato says, Theo Smyrnæus, following nature, constitutes the soul from seven numbers. These numbers are 1, 2, 3, 4, 8, 9, 27: concerning the remarkable properties of which, I refer the reader to Plutarch's Treatise on the Generation of the Soul, according to Plato, in his Timæus.

I am, Sir,
Yours respectfully,
THOMAS TAYLOR.

Walworth.

* Mathemat. p. 162.

† *Vide* Bulliald. in Theon. Mathemat. p. 284.

INGOTS OF COPPER OBTAINED BY SOLUTION.

The beautiful experiments of Sir James Hall have demonstrated that pulverised carbonate of lime, a substance eminently decomposable by heat, may be fused, under great pressure, without losing its carbonic acid, and afford, when cold, a solid mass similar to marble.

In like manner, it has been now proved that copper may be formed by deposition, from its aqueous solution; although it has been hitherto generally believed, that a solid mass of metallic copper, capable of extension, under the hammer, must have undergone igneous fusion, and have acquired its cohesion by cooling. Copper, precipitated from its solution, by whatever agent, is always in the state of a fine loose powder. The following fact, however, will show that an ingot of copper may be formed *viâ humidâ*. I am indebted to M. Mollerat for the observation, which he communicated to me a short time since, on my visiting his fine manufactory for making vinegar from wood, in Burgundy.

In a series of operations for preparing sulphate of copper by calcining copper with sulphur, solutions of the sulphate are obtained, which become turbid by the separation of an insoluble sub-sulphate. They are placed in a tub, half buried in the ground, in order to become clear. It is against the interior sides of this tub, and always at the junction of two staves, that small tufts (*champignons*) of metallic copper are observed to form, which gradually increase in size and would, doubtless, ultimately become considerable masses. I have some specimens, which I detached from the tub, with a portion of the wood adhering to them.

On one side we find these tufts of copper moulded on the wood of the tub, whose stria are impressed on their surface; on the other, they have the form of mammellæ with very minute, brilliant, crystalline facets.

One of these specimens weighs more than 75 grammes (nearly 2½ oz. English).

The chemical action, by which the copper is revived, is easily explained. The protosulphate of copper, which,

unquestionably, exists in the solution, in passing to the state of deutosulphate, deposits its base, which gives up its oxygen and acid, to form the new salt. It is evident that the revival of the copper may be effected, in this manner, without the assistance of any iron; and, in fact, there are no traces of that metal in the interior of the tub. It is not, however, this part of the phenomenon that appears to me most remarkable, but the cohesion, acquired by the copper, so precipitated, from the midst of a solution: a cohesion, which is so great as to allow the metal to be hammered in the cold, and reduced to thin leaves; and whose specific gravity is equal to that of fused copper, viz. 8·78. I have, moreover, filed a morsel of this copper, and have produced a surface as brilliant, and free from pores, as could have been obtained, by similar means, with an ingot of common copper. M. CLEMENT.

PROVINCIAL COPPER TOKENS.

Sir,—I have often regretted that the issuing of provincial copper tokens was discontinued. I know not whether they were suppressed by law, as was the case with the provincial silver, a few years ago. Their continuance would have given employment to many persons, as die-sinkers and others connected with the subject, besides giving an opportunity for improvement in the art of design and beauty of execution. It has often occurred to me, that tradesmen would do well to have tokens struck, if not issued as money, to be given in lieu of cards of address. Such a token might contain, on one side, a view of some picturesque object (and there are very few towns that do not afford some beautiful buildings) or other curious subject of local interest; and on the other, the person's address. The very implements of manufacture or articles of trade, would themselves, in many cases, form very pretty objects. Medals of this description would be considered as curiosities by many, and would be preserved with care, when a common card is usually destroyed *almost immediately*. I think in one *way they might be* made a source of profit to some trades; such as grocers, bakers, &c. We all know how anxious youth of both sexes are in the pursuit of novelties. I would say, 'If you purchase goods at my shop to the amount of a shilling, or any sum that will be a sufficient remuneration for the token above the usual profit, you shall be entitled to one.' I have no doubt but this would produce plenty of young customers, whose parents would be importuned to allow them to deal with the person where they could procure one of those pretty pieces.

These hints suggested themselves to me from looking over a great number of tokens, which I have preserved for years, some of which bear devices which are really very beautiful. I am not concerned in trade myself; otherwise I would soon carry my wishes into effect. If you should think the above worth insertion in your valuable publication, you will much oblige your constant reader, and obedient servant, G. A. E.

Chichester, Sept. 21, 1829.

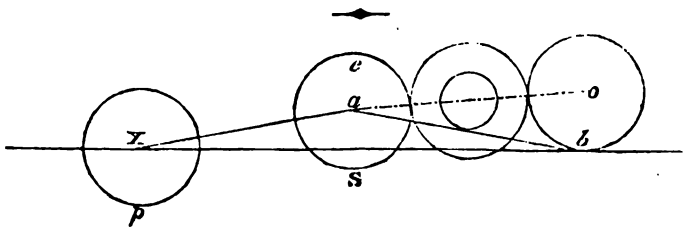
REMARKS ON HENRY D——'S SELF-ACTING RAILWAY CARRIAGE.

Sir,—It is a fact well known, that no body by descending an inclined plane can gain velocity sufficient to carry it to the summit of another plane of equal altitude. Nor can a pendulum acquire a velocity by falling through one half the arc it describes equal to the whole resistance it has to overcome in passing through the other half. These cases are quite analogous; and the same causes that prevent the perpetual oscillation of the pendulum, namely, friction and atmospheric resistance, also obstruct the ascension of a body up a plane by the mere power it has acquired by descending one of equal height. Hence no angle of inclination—no form or disposition of planes can produce the progressive motion contemplated by Henry D——; and therefore, until the laws of motion are changed, his *self-moving railway carriage* will *not* "assuredly continue to roll along in one undeviating course till time shall be no more."

Of all planes, a level one in a right line will be traversed with the least possible expense of power: for a direct line being the shortest connecting any two points, the least distance is travelled over in communicating from point to point reciprocally, with friction and resistance proportionate; whereas the proposed series of planes would materially add to the distance, and, consequently, to the friction, &c. without giving a carriage or other body one atom more power to continue its motion than it possesses on a level plane.

I have been induced to make these remarks from the analogy you have supposed (at first sight I make no doubt) to exist between Henry D—'s and Mr. Sylvester's speculations. Mr. Sylvester supposes a plane *destitute* of friction and other resistance; and that if a carriage or other body be put in motion thereon with any given velocity, it will continue to move uniformly for ever. This is a correct hypothesis, and accordant with the laws of motion; but here is no analogy, for Henry D—— has both friction and resistance. Next, Mr. S. supposes his plane to have an uniform friction, and that if a carriage or other body be put in motion thereon by some power travelling with it, sufficient to overcome this friction, the carriage or body will continue to revolve round the earth for ever. This is also correct; but again here is no analogy, for, though Henry D——'s plan is subject both to friction and resistance, it has no *power* to overcome it.

I am, Sir,
Your humble servant,
WM. GILMAN.



Sir,—It really does seem to me quite impossible that Mr. Henry D—'s "self-impelling railway carriage" should move of its own accord otherwise than as most other bodies will, *down hill*; and that being the case, it must, I presume, sooner or later, come to a stand still. It is very well known, the double cone cannot ascend (as it is called) the inclined plane, unless its centre of gravity *descends*, which may be effected by the two bars or rails composing the inclined plane, making an angle more or less acute; and it can easily be shown, that for any given cone there is a perpendicular height of the plane which cannot be exceeded: the limit of which height is the radius of the greater circle of the cone, as an inspection of the preceding figure will show. Such being the fact, suppose the cone, of which *ob* is the greater radius, has rolled up the plane or rail, its centre of gravity will have traced out the line *oa*, which necessarily *is a descending line*, and it will also be supported by its smallest diameter, because the rails are then at their greatest width asunder; from *a* to X they are parallel, and the cone will, of course, roll down them to X, at which point it will be a whole radius below its original level: it will not therefore be in *statû quo*, and the next pair of rails must commence so much below the horizontal line X*b*, which, to my mind, amounts to much the same thing as if it had descended a single inclined plane from *b* to *p*. The state of the case will be something better, if the parallel descending rails are done away with, and a second pair, similar to *ab*, commence at S; even then the cone must necessarily begin something below X*b*: the fact is, that the centre of gravity descends, and there exists the same difficulty in raising it to its former height, as in all other "perpetual motions." I am, Sir,

Yours, &c.

London, Nov. 10, 1829. R. C. Jun.

INSTRUMENTAL ARITHMETIC.

DESCRIPTION AND USE OF AN IMPROVED SLIDING-RULE, ADAPTED TO ALL PURPOSES OF COMMON ARITHMETIC. BY MR. THOMAS SADDINGTON.

(*Concluded from page* 155.)

Compound Multiplication.

Examples.

Ex. 1.—Eighteen yards of cloth at 9*s.* 6*d.* per yard.

Place 9 for nine shillings, and one and a half division for sixpence, on the duodecimal line on the slide under 1 on the middle of the stroke, which must here be called 10, and count eight of the long strokes towards 2, which will be 18 for the number of yards, under which you will have 8, and nearly three divisions (which are in this case four shillings for each stroke or division), for 8*l.* 11*s.* the answer required.

Note.—Keep in mind the rule laid down for estimating the value of any question or answer, viz. that where 1 is increased tenfold in the question, and called 10, so must the answer be increased tenfold; otherwise the point under 18 would be only seventeen shillings and one penny on the duodecimal line

Ex. 2.—Ninety-seven hundred weight of cheese, at 1*l.* 5*s.* 3*d.* per cwt.

Draw the slide out towards the right hand, and place 1 for one pound, and two of the long strokes and the next short stroke for five shillings; then estimate a quarter of the space towards the next division for three-pence under 1 on the middle of the stock, which must be called 10, and count on to 2 for 20, &c., until you come to 9 for ninety, and three and a half divisions for ninety-seven on the stock, under which you will have on the slide 1, and two long strokes and nearly half a subdivision or short stroke. By calling 1 for 100, and each of the long strokes for 10, will give a little more than 122 for 122*l.* 9*s.* 3*d.* as near as can be estimated. Here you observe, that 1 is increased to 10, and also 1 on the slide is increased to 10, which now becomes increased another tenfold, and is called 100, and each of the long strokes will be 10, and the short strokes 5.

Ex. 3.—Forty-three dozen pounds of candles, at 6*s.* 4*d.* per dozen.

Place 6 on the line of shillings, and *one division on the* duodecimal line for six shillings and four-pence under 1 on the middle of the stock, and under 43 you will have 13, and rather more than half towards the next division, for 13*l.* 12*s.* 4*d.* the answer required.

Ex. 4.—Four hundred and seven yards of cloth, at 3*s.* 9½*d.* per yard.

Estimate 3*s.* 9½*d.* on the slide by the rules laid down, and place it under 1, and look for 407, under which you will have a little more than 7, and three and half strokes for 77*l.* 3*s.* 2½*d.* the answer.

The following eight questions are selected from the rule of Practice, because being performed in the same manner as Multiplication, they are more properly introduced under this head:—

Ex. 5.—Five thousand seven hundred and four pounds at ¼*d.*?

Place ¼*d.* on the line of farthings and pence on the slide under 1 on the stock, and call 5 for 5000, and three and a half divisions for 704, under which you will have 5 on the decimal line for five pounds, and four and a half divisions (each being valued at four shillings), for 5*l.* 18*s.* 10*d.*

Note.—In this example you ascend in a tenfold degree three times. Suppose the question was 5 at ¼*d.* you would have the answer on the same line, viz. 1¼*d.* but increase the question ten times, and call 5 for 50, then the answer would be on the line of pence, 12½*d.* Increase it a second time ten times, and call 5 for 500, then the answer would be on the line of shillings, 10*s.* 5*d.* Increase it a third time ten times, and call 5 for 5000, then the answer would be 5 on the decimal line, and a little more than one division, for 5*l.* 4*s.* 2*d.* the answer.

Ex. 6.—Five thousand four hundred and seventy yards at ½*d.*?

Place ½*d.* under 1, and under 5470 you will have 11 for pounds, and nearly a short division, for 11*l.* 7*s.* 11*d.* the amount required.

Ex. 7.—Two thousand seven hundred and ten yards at 2½*d.*?

Place 2½*d.* which is on the line of pence (over one farthing on the line of farthings and pence being a tenfold increase of one farthing) under 1, and under 2710 you have a little more than 28 on the decimal line, for 28*l.* 4*s.* 7*d.* the answer.

Ex. 8.—Seven thousand five hundred and twenty-four pounds at 1*s.* 6*d.*

Here you must take 18 on the line of pence for 1*s.* 6*d.* and place it under 1, and under 7524 you will estimate rather more than 5, and three of the divisions, for 564*l.* 6*s.* the answer.

The answer to this question exemplifies the remark made in a former part of this subject, on the impossibility of estimating the exact sum in large amounts, unless the rule were made of a portionate length of radius.

Ex. 9.—Three thousand one hundred and fifty yards at 3*s.* 4*d.*?

Place 3*s.* 4*d.* under 1, and under 3150 you will find 5, and one division and a quarter, which gives 525*l.* for the answer required.

Compound Division.

Ex. 10.—The clothing of 35 charity-boys comes to 57*l.* 3*s.* 7*d.*, what is the expense of each?

Estimate 57*l.* 3*s.* 7*d.* on the slide, and place it under 35 on the stock, and under 1 on the stock you will have 1*l.* 12*s.* 8*d.* on the slide for the answer.

Ex. 11.—If 20 cwt. of tobacco comes to 27*l.* 5*s.*, at what rate is it per cwt.?

Place 27*l.* 5*s.* on the slide under 20 on the stock, and under 1 on the stock you have 1, and a little more than three and a half strokes, for 1*l.* 7*s.* 3*d.* for the answer.

Ex. 12.—A tradesman cleared 1156*l.* equally in 17 years, how much did he lay by in each year?

Place 1156*l.* under 17, and under 1 you will find 68*l.* for the answer required.

Rule of Three.

As this is a very extensive and useful rule in arithmetic, I shall introduce here a few examples generally classed under other denominations, such as interest, commission, brokerage, profit and loss, &c., which are only modifications of the rule of proportion.

Ex. 13.—If I gave 4*l.* 18*s.* for 1 cwt. of sugar, at what rate did I buy it at per lb.?

Here you must note that 112lbs. is equal to 1 cwt.

Place 4*l.* 18*s.* under 112, and under 1 you will have 10½*d.* for the answer.

Ex. 14.—If 1 cwt. of cheese cost 1*l.* 14*s.* 8*d.*, what must I give for 3½lbs.?

Place 1*l.* 14*s.* 8*d.* under 112, and under 3½ you will have 13*d.* for 1*s.* 1*d.* the answer.

Ex. 15.—What is the interest of 375*l.* for one year at 5 per cent.?

Call 1 in the middle for 100, and place 5 on the slide under it for the rate per cent., and under 375 for lbs. you will have 18¾ for 18*l.* 15*s.* for the answer.

Ex. 16.—My correspondent writes me word that he has bought goods to the amount of 754*l.* 16*s* on my account, what does his commission come to at 2½ per cent.?

Place 2*l.* 10*s.* for 2½, the rate per cent. under 1 for 100*l.* and under 754*l.* 16*s.* you will have nearly 19, viz. for 18*l.* 17*s* 4½*d.* for the answer.

Ex. 17.—If I employ a broker to sell goods to the value of 2575*l.* 17*s.* 6*d.*, what is the brokerage at 4*s.* per cent.?

Place 4*s.* the rate per cent. under 1 for 100*l.*, and under 2575*l.* 17*s.* 6*d.* you will have 5*l.* 3*s.* for the answer.

Ex. 18.—If a broker is employed to buy a quantity of goods to the value of 975*l.* 6*s.* 4*d.*, what is the brokerage at 6*s.* 6*d.* per cent.?

Place 6*s.* 6*d.* the rate per cent., under 100, and under 975*l.* 6*s.* 4*d.* you will have three and nearly two divisions for 3*l.* 3*s.* 4*d.* the answer.

Ex. 19.—What is the interest of 257*l.* 5*s.* 1*d.* at 4 per cent. for one year and three quarters?

Note.—The solution to this question requires two operations, because the question is for a year and part of a year.

Place 4 for 4*l.* the rate per cent. under 100, and under 257*l.* 5*s.* 1*d.* make a small mark with a soft black lead pencil (which may be easily rubbed out again) on the slide, then remove this mark under one and three quarters, that is to say, at 17½, between the figures 1 and 2, under which you will then have 18 for 18*l.* 0*s.* 1½*d.* the answer.

Ex. 20.—What is the interest of 259*l.* 13*s.* 5*d.* for twenty weeks at 5 per cent.?

Place 5, the rate per cent., under 100, and under 259*l.* 13*s.* 5*d.* you have the amount of interest for one year; at that point make a small mark, as before directed, on the slide, and then remove it under 52 for the number of weeks in one year, and under 20 you will have nearly 5, viz. 4*l.* 19*s.* 10½*d.* for the answer.

Ex. 21.—If one yard of cloth is bought for 11*s.* and sold for 12*s.* 6*d.*, what is the gain per cent.?

Note.—This, and all similar questions where shillings and pence or feet and inches are the first term, will illustrate the advantage derived from the upper part of the rule, being divided and subdivided into shillings and pence in the same manner as the slide.

Place 12*s.* 6*d.* on the slide under 11*s.* on the stock and under 1, which is now 100, the rate per cent., you will have 113½ on the slide, being 13½ above 100, which is the rate per cent. profit, the true answer is 13*l.* 12*s.* 8*d.* per cent.

Questions of this nature may be worked another way. The cloth is bought for 11*s.* per yard, and sold for 12*s.* 6*d.*, which leaves a profit of 1*s.* 6*d.* per yard. Then say, if 11*s.* gives 1*s.* 6*d.*, what will 100*l.* give? Place 18*d.* for 1*s.* 6*d.* on the slide under 11*s.* on the stock, and under 100 on the stock you will have a little more than 13½ on the slide, the rate per cent., for the answer required.

Ex. 22.—If 1lb. of tobacco cost 16*d.* and is sold for 20*d.*, what is the gain per cent.?

Place 20*d.* on the slide under 16*d.* on the stock, and under 100 on the stock you have 125, which is 25 above 100, for the answer.

This question may be worked in the same manner as the last, and say, if 16*d.* give 4*d.* profit, what will 100*l.* give?

Place 4*d.* on the slide under 16*d.* on the stock, and under 100 you will have 25 the rate per cent., for the answer.

Ex. 23.—Bought 124 yards of linen for 32*l.*, how should the same be retailed per yard to gain 15 per cent. profit?

Place 32 for pounds on the slide under 124 for yards on the stock, and under 1 on the stock you have 5*s.* 2*d.* on the slide for the cost price of one yard, and under 115, being 15 above 100, you have 5*s.* 11¼*d.*, the answer for the value o fone yard when sold to gain 15 per cent. profit.

This question may be worked another way, and say, if 100 gives 5*s.* 2*d.* the cost price of one yard, what will 15, the rate per cent., give?

Place 5*s.* 2*d.* under 100, and under 15 you will have 9½*d.* for the profit to be added to the cost price to gain 15 per cent.

Ex. 24.—*If 1* yard of cloth cost 13*s.* 4*d.*, what must I sell it for to gain 20 per cent.?

Place 13*s.* 4*d.* on the slide under 100 on the stock, and under 120 on the stock you have 16*s.* on the slide for the price of 1 yard when sold to gain 20 per cent. profit.

This question, as the last, may be worked another way, and say, if 100 gives 13*s.* 4*d.* the cost price, what will 20, the rate per cent. profit, give?

Place 13*s.* 4*d.* under 100, and under 20 you will have 2*s.* 8*d.* to be added to the cost price to gain 20 per cent.

Ex. 25.—What is the interest of 240*l.* for 120 days, at 4 per cent. per annum?

Place 4 for the rate per cent. under 100, and under 240 on the stock make a small mark on the slide (as before directed in Examples 19 and 20), then remove this point under 365 for the number of days in one year, and under 120, the number of days, you will have 3*l.* 3*s.* 1*d.* for the answer required.

Ex. 26.—What is the interest of 364*l.* 18*s.* for 154 days, at 5 per cent. per annum?

Place 5, the rate per cent. under 100, and under 364*l.* 18*s.* make a small mark on the slide, then place this mark under 365, the number of days in one year (which you will perceive is already done in this Example as near as can be estimated), and under 154 you will have 7*l.* 14*s.* for the answer required.

Cross Multiplication.

Having explained the advantages to be derived by the use of the improved sliding-rule in transactions of common arithmetic, I shall now proceed with a few examples in duodecimal arithmetic, or what is generally called cross multiplication and squaring of dimensions by artificers and workmen in superficial and cubical measure.

In finding the superficial or cubical contents, you must make use of the decimal line for inches; when the terms are between one foot and ten feet, you must work with the decimal line in the same manner as if you were working with integral numbers. Again, if either of the terms are under one foot, you must use the line of pence for the parts of a foot required.

Ex. 27.—Multiply 7 feet 7 inches by 3 feet 6 inches.

Place 7 on the decimal line and three

of the divisions on duodecimal line for 9 inches (each division between 7 and 8 being 3 inches) on the slide under 1 on the middle of the stock, and under 3 on the decimal line, and three of the divisions on the duodecimal line on the stock for six inches (each division between 3 and 4 in this Example being for two inches), you will have on the slide a little more than 27 on the decimal line on the slide for 27 feet 1½ inches, the answer required.

Ex. 28.—Multiply 8 feet 5 inches by 4 feet 7 inches.

Place 8 on the decimal line, and nearly two divisions on the duodecimal line, (each division between 7 and 8 being three inches,) on the slide under 1 on the stock, and under 4 on the decimal line, and a little more than three divisions on the duodecimal line on the stock, you will have 38½ on the decimal line, for 38 feet 7 inches, the answer.

Ex. 29.—Multiply 9 feet 8 inches by 7 feet 6 inches.

Place 7 feet 8 inches on the slide under 1 on the stock and under 7 feet 6 inches on the stock you will have 77½ on the slide for 77 feet 6 inches, the answer required.

Ex. 30.—Multiply 8 feet 1 inch by 3 feet 5 inches.

Place 8 feet 1 inch on the slide under 1 on the stock, and under 3 feet 5 inches on the stock you will have rather more than 27½ on the slide for 27 feet 7 inches, the answer required.

Ex. 31.—Multiply 75 feet 7 inches by 9 feet 8 inches.

Place 75½ on the decimal line under 1 on the stock, and under 9 on the decimal line, and nearly three divisions on the duodecimal line for 8 inches on the stock, you will have 7 and two and half divisions on the decimal line for 730 feet, the answer.

The two following Examples will illustrate the method of proceeding when one of the terms is under 1 foot; in which case you must place the number of inches on the line of pence under 12 on the decimal line on the stock, instead of placing it under 1, or unit, as in the foregoing Examples, because 12 is the number of inches in one foot.

Ex. 32.—Multiply 9 inches by 14 inches.

Place 9 on the line of pence on the slide under 12 on the decimal line on the stock, and count to 14 on the same line, under which point on the slide you will have 10½ inches on the line of pence for the answer required.

Ex. 33.—Multiply 6 inches by 24 inches. Supposing a board to be 6 inches wide, and 24 inches long, what is the superficial contents?

Place 6 on the line of pence on the slide under 12 on the decimal line on the stock, and under 24 on the same line on the stock you will have 12 on the line of pence on the slide for 12 inches, or 1 foot, for the answer required. If this question had been 6 inches wide and 60 inches long, the answer would have been 2 feet 6 inches.

Cubical measure requires two operations because the first and second terms are multiplied into each other, and the product multiplied into the third term.

Ex. 34.—What is the cubical or solid contents of a stone or box 3 feet 6 inches wide, 4 feet 8 inches long, and 2 feet 3 inches deep?

Place 3 feet 6 inches under 1, and under 4 feet 8 inches you will have 16 feet 4 inches on the slide, at which place make a small mark with pencil, and remove this point under 1, and under 2 feet 3 inches you will have nearly 37 for 36 feet 9 inches, the answer.

Ex. 35.—What is the cubical contents and amount of freight of a chest of Irish linen 1 foot 8 inches wide, 4 feet 6 inches long, and 1 foot 6 inches deep, at 2*l.* 15*s.* per ton, from London to Quebec?—*Note.* Forty cubical feet is 1 ton for measurement goods.

Place 1 foot 8 inches under 1, and under 4 feet 6 inches you will have 7 feet 6 inches, which must be removed under 1, and under 1 foot 4 inches you will have 10 feet for the cubical contents. Then place 2*l.* 15*s.* the rate of freight under 40, the number of feet in one ton, and under 10 feet, the contents of the chest in measurement, you will have 13*s.* 9*d.* for the amount of freight.

Ex. 36.—What is the cubical contents and amount of freight of a bale of woollen cloth 2 feet 11 inches wide, 5 feet 6 inches long, and 2 feet 8 inches deep, at 4*l.* 10*s.* per ton?

Place 2 on the decimal line and eleven divisions on the duodecimal line on the slide under 1 on the stock, for 2 feet 11 inches, and under 5 on the decimal line and two divisions on the duodecimal line on the stock for 5 feet 6 inches, you will have 16 feet on the

slide, which you must remove under 1; and under 2 on the decimal line and eight divisions on the duodecimal line on the stock for 2 feet 8 inches you will have 4, and nearly three divisions on the slide for 42 feet 9 inches for cubical contents, the answer. Then place 4*l.* 10*s.* the rate of freight, under 40, the number of feet in one ton, and under 42 feet 9 inches, the cubical contents of the bale, you will have 4*l.* 16*s.* 2*d* for the amount of freight.

In the foregoing Examples I have fully illustrated with peculiar minuteness the principles and advantages of the improved sliding-rule, from which it will be readily acknowledged to be an expeditious computator, and a valuable companion either for the pocket or the desk. I would again remind the reader of what has before been stated; namely, that in using the sliding-rule it is not intended that it should supersede the use of figures in the common mode of making calculations where accuracy is required, but the utility of the rule will be fully admitted as a corrector in all operations in proportion to the size of the instrument: for by adjusting the slide to the respective questions, the solution is instantly obtained, whereby the calculator will be enabled to judge if his computations are correct; if not, the error, if considerable, will be immediately detected. Where great accuracy is not necessary, and only the proximate value or amount of any question required to be instantly ascertained, or in working of low numbers, much gratification will result from the use of this instrument.

Improved sliding-rules accurately laid down, either 6, 12, or 24 inches long, may be had on application to me, No. 8, Upper John-street, Commercial-road,

THOMAS SADDINGTON.

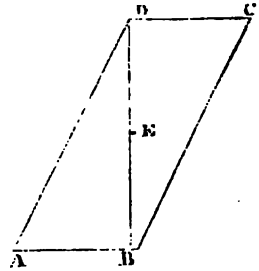
ANSWERS TO THE MATHEMATICAL EXERCISES PROPOSED IN NO. 316, p. 13.

Question Third.

"The slant height of a wall is equal to twice its horizontal thickness; find its inclination when it will be just supported."

By Mr. J. Gilbert, Jun.

When the wall is only just supported, the line drawn from its centre of gravity perpendicular to the surface of the earth will, it is well known, pass through the edge of the base.



Let A B C D be the wall; E its centre of gravity; E B produced will evidently pass through D: A B D is therefore a right-angled triangle, of which AB=1, AD=2: therefore, by plain trigonometry,

2 : rad. :: 1 : cos. of angle A=30°.

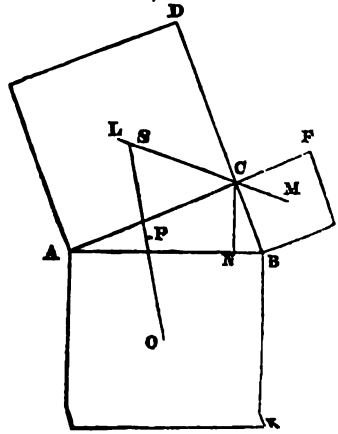
Whence angle A=comp. of 30=60° =angle of inclination when the wall is just supported.

[Similar solutions have been received from Mr. Hogan (the proposer of the question), Mr. Hughes, A Reader at Liverpool, Cosine, and Adelphi: Kappa's answer is wrong by between two and three degrees.]

Question Fourth.

"To find the centre of gravity of the three squares described on the three sides of a right-angled triangle."

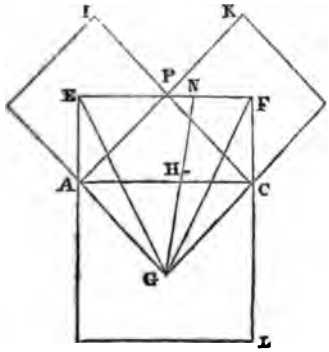
By Mr. Thomas Hughes, Mansion-House School, Hammersmith.



Let A B C be the right-angled triangle, and L, M, and O the intersections of the diameters of the three squares, described upon the three sides of the triangle A B C: then will L, M, and O be the centre of gravities of the three squares. Draw C N perpendicular to A B, join L C and C M; because L C A and M C B are each half a right angle, and A C B is a right angle ∴ L C M is a straight line. Divide L M in S. To that M S : S L : : A N : N B join S O, which bisect in C, then will C be the centre of gravity of the three squares, A D, B F, and A K.

For $AC^2 = AB$, AN, and $CB^2 = AB$, BN (8 and 6 Elem.) ∴ $AC^2 : CB^2 :: AN : NB :: NS : SL$ ∴ S is the centre of gravity of the two squares AD and BF, and S was the square AK = to the two squares AD and BF, and that SO is bisected in C. Therefore C is the centre of gravity of the three squares AD, BF, and AK.

By Mr. Tho. Hogan (the Proposer).



Let APC be the given right-angled triangle, right-angled at P; describe the squares AI, CK, AL, of which E, F and G are the centres of gravity, join EF, FG, GE; divide EF in N, so that EN : NF :: square CK; square AI; join GN, which bisect in H (because AL = AI + CK, (47. E.)) and H is the centre of gravity required. *Calculation*: put AP = c, PC = a, AC = b, then $EP = \frac{c}{\sqrt{2}}$, $PF = \frac{a}{\sqrt{2}}$ ∴ EP + PF = EF = $\frac{a+c}{\sqrt{2}}$; and because EN : NF :: $a^2 : c^2$, hence EF : NF :: $a^2 + c^2 : c^2$ ∴ $NF = \frac{a+c}{\sqrt{2}} \times c^2 \div \sqrt{a^2 + c^2}$, and $EN = \frac{a+c}{\sqrt{2}} \times a^2 \div \sqrt{a^2 + c^2}$

in the △EAG, we know AE, AG, and the ∠EAG; hence we can find EG, in a similar manner, in the △GCF, we know GC, CF, and the ∠GCF, hence we can find FG: again, in the △EGF we know all the sides, hence the angle GFN is known; lastly, in △GFN we know GF, FN, and ∠GFN, hence we can find GN, which bisects in H, and it will be the centre of gravity required.

[Solutions have been also received of this question from Mr. Gilbert; Herbert D.; P. T., and H. Paynton. Herbert D. remarks truly, that in the same way "the centre of gravity of force, or any greater number of bodies, may be ascertained. The first and second are to be considered as a single body, placed in their common centre of gravity; and the centre of gravity of this body and a third is to be determined. These, in like manner, being considered as united at their common centre, we may proceed to a fourth, and so on.]

Solutions of the algebraic exercise in No. 316 in our next.

MECHANICAL AND MATHEMATICAL EXERCISES.

[*Answers to be sent before the 1st of January, 1830, when the best of those then received will be selected for publication.*]

1. *Proposed by Mr. Lucock, of Birmingham.*

A box exactly 12 inches square having lost its lid, it is proposed to make a new one out of a board 9·6 inches by 15. How can this be accomplished?

2. *By Omicron.*

Given the hypothenuse of a right-angled triangle 1000000,000001 feet, and the base 999999,999999 feet. To find the perpendicular?

The question is simple, but will be found in its results extremely curious.

3. *By Senex.*

The inhabitants of a certain street have agreed to have for their exclusive use a fire-pump; but the son of one of them, who is learning at the London University how to set people by the ears, tells his father that, as the houses on one side of the street are only three stories high, and those on the other five, the former ought not to be charged with the expense of the extra forcing power, and extra length of hose, required for the latter. Will some reader of "the Mechanics' Magazine" be pleased to determine how the fact stands, and to say in what different proportions (if they are different) the inhabitants of the two sides of the street should contribute to the expense?

ALGEBRAICAL PROBLEM.

Proposed by Mr. J. Gilbert, jun.

[*Answers to be sent in before the 1st of January*, 1830.]

Let there be given the sum (S) of any given number of terms in geometrical progression, and the sum (S') of the two extremes; it is required to find the terms of that progression when the multiplier, by which they increase, is 2.

Lemma, on which the solution depends.

Let y be the second term of any geometrical progression, the multiplier being 2.

Let $x+y+z+w+l+r=\mathrm{S}$
and $x \qquad +r=\mathrm{S}'$;
then we shall have $2y+\frac{1}{2}y+z+w+l=x+r=\mathrm{S}'$.

DECAY OF STONE CORNICES.

Sir,—It appears to me that the quick decay of the corner parts of mouldings, cornices, &c. in comparison with the upper parts of the same members, (see Inquiry, No. 319, p. 64,) may be attributed to the rain-water; for if we attentively examine any external moulding or cornice after a shower of rain, we shall find that the lower parts remain wet much longer than the upper ones; the lower parts are thereby exposed to the influence of expansion, (during the frequent and sudden changes, from wet to frosty weather, which our climate is *liable to during the* winter months,) in a much greater degree than the upper parts.

The prejudicial effect of rain-water upon projections of this description, does not arise from expansion alone, which would perhaps only prove injurious during the winter months; for even in the mildest weather, the carbonic acid contained in rain-water acts chemically upon the description of stone generally used for building purposes, and to this action the lower parts of cornices, &c. are of course much more exposed than the upper parts. If the above suppositions are wrong, I hope some of your correspondents will contradict them, and state the true cause, for the information of your readers, including your humble servant.

PIT.

[T. of East-place, Lambeth, has favoured us with a similar explanation.—ED.]

CANALS AND RAILWAYS.

Sir,—In one of your interesting communications concerning locomotive engines, I think I read something about filling up canals and laying down railroads upon this new surface. Now, why not simply drain the canal, and by a comparatively small use of the spade form a way for the rails on the bottom of it? The expense could not be excessive; and by this method you would obtain room enough for the tallest of the Liverpool engines to pass under the bridges. A gradually inclined plane might be formed at the places where there are locks, or a stationary engine fixed. How soon by these means might we have a greatly-accelerated transit of merchandise every where, and I believe to the great emolument of canal proprietors. Should you think this common-sense idea worth your editorial notice, we may expect to see more of it in your very useful Magazine.

Yours, &c.
WM. D. R.

Chelsea, Nov. 19, 1829.

[It was not "the filling up of canals" which we recommended, but the laying down of railways along each canal; on the side, for example, not occupied as the towing-path, so that the advantages of canal and railway conveyance might be combined. We think this plan preferable to doing away with a canal altogether; for in all cases where a speed of not more than two miles per hour is wanted, twice the weight can be

moved on a canal which can be propelled on a railway by the same power. We shall not be at all surprised, however, should the proprietors of some of those canals on which the traffic in heavy goods is unimportant, find it ere long to their advantage, to do even as our correspondent suggests. One or two we do know of, that could do nothing better.—EDIT.]

RAILWAYS IN LONDON.

Sir,—We talk about railways, their utility, the speed with which our gentlemen of the nineteenth century will travel from London to Edinburgh in a twinkling, &c. &c. All this is very well; but how can we, after having been wafted from place to place on the wings of the wind, endure the shaking of London stones. *Now* we find it a perfect nuisance; then it will be unendurable. Is it impossible to devise a remedy? Suppose we turn the streets of London into rail-roads. It is no Utopian scheme; the plan is a very simple one. Sink in narrow streets two, and in broad streets four rows of curb stones, at proportionate distances: here we have a rail at once, with scarcely any trouble, and at a small expense. How pleasant would it be to ride through the metropolis were this plan adopted! No jolting, no rumbling of wheels; a hundred inconveniencies avoided. I should like to know what obstacle prevents the adoption of this plan forthwith.

I am, yours, &c.

Nov. 18, 1829. NEMO.

Inquiries.

Æolian Harp.—Sir, Your correspondent G. J. G., p. 331 of vol. ix. of the "Mechanics' Magazine," in his excellent and familiar illustration of the Theory of Harmonics, has given a slight description of the Æolian harp. I have for a long time had boards cut out, intending to construct one of those simple instruments; but as it is some years since I saw one, and that a very old one, and thinking the description given by G. J. G. not sufficiently explicit for my purpose, I have been deterred from making the attempt. If G. J. G., or some of your correspondents, could give through your useful publication some further information on the subject, I should take it a favour. I particularly wish to know, 1. The thickness of the end boards; and as the boards which form the top, bottom, and sides *are so very* thin, whether any lining of slips of deal is required to strengthen the joints? 2. Whether the strings are stretched upon the pins and pegs without any support at the ends for the strings to rest upon? 3. What the distance is from the top to the strings? And, 4. whether the pins and pegs are to be of wood, and of what size? When tuned, your correspondent says, that the outside or largest strings should be tuned to E or F below gamut, and the middle or smaller an octave higher. Now supposing the instrument to have eight strings, I wish to know if the six middle strings should be of one sound; if not, what they ought to be?

I am, Sir,

Your obedient Servant,

Hinxton. J. H. R.

Horn Paper.—Mr. Editor, As a subscriber to and constant reader of the "Mechanics' Magazine," I shall feel particularly obliged to any of your readers who will inform me the ingredients used for making what is called horn-paper. I know for certain that the paper made use of is what is termed "sixpenny drawing paper;" but am not aware how it is prepared.

CLERICUS.

Tea Stains.—Sir, Perhaps some of your numerous correspondents could inform me through your pages, how to extract tea-stains from a buff-coloured muslin; the stains are perfectly black.

Your obedient Servant,

and Well-wisher,

KAPPA.

Scagliola.—How is scagliola manufactured, and by what process is it polished? I have tried as directed in Nicholson's Operative Mechanic, but without success.

A MASON.

Sept. 5, 1829.

Oriental Tinting.—What is the process of oriental tinting, and the description of utensils employed?

J. N——y.

[We have received a great many other inquiries to the same effect.—ED.]

Knife Cleaner.—Sir, An inn-keeper wishes to be informed of a cheap and expeditious knife and fork cleaner? Any of your mechanical friends who would give a plan for the construction of such an article, would confer a general benefit.

I am, &c.

L. A.

Effect of Damp on Brass Wire.—Sir, A friend of mine lately informed me that he hung up some brass wire in his warehouse, and that part of it which was exposed to damp became to his astonishment, after a short time, as brittle as glass, while that which hung in a dry place was not injured at all. Is there any remedy for wire thus injured? and what is the reason that damp should affect it in so extraordinary a manner?

I am, &c.

B. S.

Purifying Oil.—Sir, Having seen in some periodical, (I believe the *Literary Gazette*,) an account that oil may be purified so as to burn with brilliancy equal to that of gas, by filtering it through charcoal—permit me through your valuable pages to inquire of your correspondents, if any of them can give the particulars of the process. I should also like to know, whether oil that has been kept over last season will answer the purpose? What makes me address these inquiries to you is, that I cannot make my oil (though quite clear) burn in the common way, unless with difficulty; the light being dull and heavy; the wick too continually charring, and therefore often wanting snuffing, otherwise it soon extinguishes. Nor is this the only season I have experienced the same inconvenience. If any of your readers can account for this, or say what I should do to prevent it, they will oblige one who is willing to give as well as receive.

A West Countryman.

P. S.—Since writing the above, I have seen a notice of a lamp called Bright's Shadowless Lamp. Can any of your correspondents favour us with some particulars respecting it? How has it been found to answer in practice? It appears to me to be a very complex thing.

Depriving Oil of Colour.—Can oil (linseed oil in particular) be deprived of its colour, by any simple means, without the use of expensive apparatus?

Aldersgate, P. Z.
August 28, 1829.

Softening Hard Water.—Sir, I have a good well of spring water, but its hardness renders it unfit for many domestic purposes. I should feel greatly obliged if any of your correspondents could point out an easy method of softening it.

I am, Sir, yours,
Westminster. W. S.

Spirits of Turpentine.—Whether it be possible, and, if so, what are the means to be used, to take away or neutralize the peculiar odour of the *spirits of turpentine?* It is immaterial whether the article employed to effect the above desideratum be held in chemical solution or mechanical suspension.

J. M.

Erection of Fountains.—Sir, I will thank any of your correspondents to inform me through the medium of your excellent Magazine, the best plan of erecting a fountain at a moderate expence, and on a small scale, in an enclosure before a neat cottage. The land is level round about, but there is plenty of water.

I am, &c.

Stockport, S. G.
Nov. 18, 1829.

Packing Wool.—Sir, Being an extensive sheep farmer, and finding in common with others of my class, the great injury which the low price of wool inflicts on us, it becomes necessary to endeavour by all means in our power to diminish the expenses attendant on bringing our produce to market. My farm is situated in a very distant part of the island, so much so, that my wool is always sent by sea to Yorkshire for sale. The great volume which the present defective method of packing wool occasions it to occupy, causes the freight to be very heavy; and I wonder very much that no machinery, such as is used for compressing cotton, has been introduced into common use, for the purpose of packing the wool into the same small compass in which the cotton arrives in this country. It may however happen, that there may be something of the sort in existence, which has escaped my notice. I trust in consequence, that you will be kind enough to publish this letter, in the hope that, in reply, I may hear of some machinery which might answer the purpose required. It strikes me that the staple of the wool would not be at all injured, and that a much less freight would be required than when the wool occupies its present extended volume.

I remain, &c.

Peter.

[If our correspondent will consult our 270th Number, he will find in it a description by Mr. Davy of a compressing machine which will probably suit his purpose.—Ed.]

MINOR CORRESPONDENCE.

Wasp or Bee Stings.—Sir, In your Magazine for October last, I perceive your correspondent "P" has given a method of curing the "sting of a wasp or a bee;" also, of preventing inflammation where a person has swallowed a wasp: the former by rubbing the part affected with salt and water, and the latter by swallowing salt dissolved in the mouth. I have had several years' experience in the management of bees, and have reason to know that the puncture made by a sting is extremely small, and that in nine times out of ten a person may rub the part a hundred times with salt and water, and not reach the venom. As to his preventing internal inflammation from a sting by swallowing salted saliva, I should be glad to know if he ever tried the experiment, or if he be willing to try it? For stings on my hands and face, I have frequently tried acids and alkalies, and a variety of fluids recommended by Huish and others; and if any of them reached the poison, the pain and swelling immediately subsided, but that was rarely the case. The only method I could depend upon was squeezing the part as soon as possible betwixt the thumb-nail and fore-finger, till I could perceive blood in the puncture; and this I have found a never-failing cure. I have several times been stung in the fleshy part below the eye, and have had it squeezed, as above-mentioned, immediately by another person; and I have never known the operation to fail of success. As to the cure of a sting inwardly, I do not pretend to prescribe: I should have faint hopes of surviving the experiment, though I were drenched copiously with salt.

I am, Sir, your obedient servant,
Shrewsbury, Nov. 7, 1829. H.

Jackson's Patent Stud for Shoes, &c.—Sir, I ought not to be behind "Mr. Bricklayer" in thanking you for your recommendation of Jackson's studded shoes. Having the Tower-hill district of the Foreign-post under my charge, and of course a great deal of walking, economy in leather is to me an object of the first importance. It is now several months since I had recourse to the studded shoes, and find them to last beyond comparison better than any I ever wore. I can confidently recommend them to my brethren in his Majesty's post-offices, and to pedestrians in general, as most serviceable and desirable. I think they are the best things of the kind yet invented; and I beg leave to add my mite to their praise in your very valuable work, and

I remain your obedient servant,
Nov. 16, 1829. L. SMITH.

Improvement in Type.—Sir, A thought having struck me that much time and expense might be saved, by using a different sort of type to that at present used in printing; I have written to you, in order that if you think the idea worth any thing, you may give it a corner in your valuable publication. My plan is the following:—Instead of each type having one face, let it have two of the same kind one on each side. By this method, a man might compose two sets of types at the same time, and also strike off two copies at the same time; by which means an immense portion of time and trouble might be saved, and thereby much expense.

I am, Sir, your most obedient servant,
E. R. A. P. P.
Cambridge. (G. and C.) C.

Consumption of Smoke—Improvements in Steam Engines, &c.—Sir, As the "Proprietor of a Foundery" at Birmingham (No. 327, p. 208,) is no doubt in earnest, I beg to inform him, that if the person he addresses himself to should not give him the satisfaction he expects, I shall be happy afterwards to offer myself to his notice. I began to make a steam-engine, ten years ago, just large enough for me to carry; but was obliged to give it up for want of means to go on. I have of late made great improvements in the boiler, by lessening its size, increasing the heat, abolishing the smoke, and doing away with the chimney altogether. I believe that a boiler on my plan will produce double the effect of that of Messrs. Braithwaite and Ericsson's. I set out years ago with this text, that it is not the greatest quantity of water that gives the greatest quantity of steam, quite the contrary—it is the greatest quantity of liquid surface, in direct contact with the fire. If the gentleman of Birmingham, or any body else, should adopt my plan, I have no doubt they will find their account in it. I think if one part of this contrivance were to be applied to a condensing engine, it would enable it to work always with the same water; but of the certainty of this, experiment must determine. Persons who pay the water companies from 50*l.* to 60*l.* a year for an insufficient supply of injection water (and I know many that do so), might find their account in this also. And if it should answer, the condensing engine might easily be made locomotive, when it would be preferred by thousands to the high pressure one, as was the case with steam-boats when they first came in. With respect to cleaning out the boiler, that is what I have had great attention to, that it may be done quickly, with certainty, and with ease. I was much pleased with a remark of yours respecting Mr. James's plan for the purpose, (No. 327, p. 197,) and I am sure every one who has had to clean out steam-boilers will be of the same opinion. The *playing at marbles* I know went do, perhaps if they were made of steel, and fitted all over and hardened, they might stand a better chance: but the whole will prove a loose thing, I guess.

I am, Sir, yours, &c.
R. M. FRANKLIN.
North place, Wheatsheaf-court, Somers-town,
Nov. 19, 1829.

Painting on Parchment.—A correspondent ("Art") recommends to such of our readers as may have occasion to use water-colours on parchment, to go over with alum-water the parts intended to be coloured, in addition to mixing up the colours with it, as recommended by our correspondent "Edward," at p. 330 of our first volume.

MISCELLANEOUS.

Canals of Great Britain.—According to a calculation recently made, there are one hundred and eight canals in Great Britain, extending 2682 miles, formed at an expense of thirty millions sterling.

Self-winding Clock.—The *Connecticut Register* states, that a person in that state has invented a clock which winds itself up, and keeps correct time, strikes the hour regularly, and will continue to run until worn out, without the application of any power external to itself.

Ripening Wall-Fruit.—A vine-branch had been trained above the window of a house facing the south, according to custom, in certain parts of France. Beneath this branch was a small slate roof, about 3 feet wide, serving to shelter a door. It was remarked, that the grapes on this roof were ripe and black, whilst those on the rest of the branch were yet green. This effect, evidently due to the heat accumulated in the slates from the rays of the sun, has been advantageously applied in assisting the ripening of wall-fruit."—*M. Bouchard*—*Bull. Univ. D. N.* 230.

Permanent Ink.—Mr. Murray says, he found ink made of the following ingredients triumphant over the most violent chemical agencies, and of whose permanence in valuable records there can be no doubt :—

½ oz. of a solution of nitrate of silver,
1 oz. . . . . nitrate of iron.
½ oz. . . . . prussiate of ammonia.
½ oz. of tincture of galls."

A portion of finely levigated Indian ink and gum arabic added to these ingredients, is recommended by Mr. Murray. The fluid ounce is to be here understood.

Braconnot's Indelible Ink, or Dye.—" Twenty parts of Dantzic potash were dissolved in boiling water, and 10 parts of tanned leather parings, in small pieces, with 5 parts of sublimed sulphur, added; the whole was boiled to dryness in an iron vessel; then heated more strongly with continual agitation, but avoiding ignition, until the whole became soft; then a proper quantity of water was gradually added, and the whole filtered through a cloth. In this way a very dark-coloured liquor was procured, which may be preserved for any length of time in well-corked vessels, constantly excluded from the air: this presents no difficulty to its use, for a pen-full is sufficient to write a couple of quarto pages. It flows much more freely than ordinary ink, does not embarrass the pen with insoluble matter, and resists chemical agents in such a way as to merit the title of indelible ink."—*Ann. de Chimie*, vol. xl. 221.

Navigation of the Shannon.—We have once or twice incidentally mentioned, with due commendation, a pamphlet by Thomas Steele, Esq. entitled " Practical Suggestions on the General Improvement of the Navigation of the Shannon, between Limerick and the Atlantic." It gives us now much pleasure to learn, that most of these suggestions are in a course of being acted upon, under the sanction and direction of the Chamber of Commerce of Limerick; which has, among other things, recently made application to the Ballast Board of Dublin for the erection of a lighthouse on the Tarbert Rock—one of the improvements most earnestly recommended by Mr. Steele. Limerick, as Mr. S. remarks, " though not a town upon the western coast of Ireland, has the advantage of being deep set on a long inlet towards the heart of the country;" and is thus admirably adapted by its situation to form the seat of an extensive commerce with the West Indies and America, on the one hand, and Dublin, Liverpool, Bristol, Glasgow, &c. on the other; but in consequence of the many dangerous obstructions which exist to the navigation of the Shannon, it has not as yet reaped one half the benefit which it might derive from its geographical position. We apprehend, however, that Limerick is in this respect but a type of the general condition of Ireland, the capabilities and resources of which have as yet been only very partially developed. It is with unmixed satisfaction we hail the dawn of a brighter era.

The Holyhead Road and Menai Bridge.—The following eloquent tribute to the merits of these great works appears in the dedication to Mr. Telford, of the work of which we have just quoted, on the navigation of the Shannon, by Thomas Steele, Esq.:—" On the evening when I took my seat as an associate member of the Institution of Civil Engineers, I signed in your presence a declaration that I would always, to the utmost of my power, endeavour to promote the objects for which the society had been founded; and I now, without at all identifying you with my politics, beg permission to dedicate to you the following pages; that at the same time, *when I make an humble effort to fulfil my pledge to the institution, I may, as an Irishman*, have the gratification of publicly expressing my sense of the benefit you have conferred on my country, by increasing to the extent that you have increased it, the rapidity of communication between Ireland and England. In the progress of your work, Sir, for drawing the two countries by so many hours nearer to each other than they were before, you have not only formed one of the most magnificent roads in the world over the mountains of Wales, but you have suspended in the midway air—not over a river, but over a portion of the mighty deep itself—a monument to your genius, harmonizing with the objects around, beneath and above, for, like the ridge of the Cambrian mountains, the ocean-tide and the firmament of Heaven,

' This new wondrous Pontalice unhoped,'
(Milton)

the bridge over the billows of the Menai is sublime!"

INTERIM NOTICES.

We presume we are indebted to *Civis* for a copy of the Chester Advertiser, in which there is a letter with that signature on the late Railway Competition, in which the anonymous writer accuses us of making " erroneous statements," " party spirit," &c. Of the value of Civis's censure, the reader may judge from a slight specimen or two. He says, that " The Novelty" (which it is his object in the end to decry) " was constructed with great attention to appearance and effect, its carriage was light and elegant, and its works being covered in under a copper cap, its motion (as it were without a cause) had the air of magic." Now, so little truth is there in all the latter part of this statement, that the only part " covered in under a copper cap" was the steam chamber; and all the other parts of the engine, except the furnace and its flue, were exposed to view. If the reader will have the goodness to refer to the engraving which accompanies our present Number, he will perceive that " the works" of " The Novelty" were in truth *more* exposed than those of either of the other engines. Again we are told by *Civis*, that " another accident which befel this beautiful little engine has, by the 'Mechanics' Magazine' been ascribed to the unfavourable state of the railway, while it was actually owing to the bursting of the bellows!!" A gross and necessarily a wilful misrepresentation. The " Mechanics' Magazine' never did ascribe any accident which befel " The Novelty" to any such cause, and no " bursting of the bellows" was ever before heard of.

We have already disposed of the Mathematical Question, No. 2, p. 13, of our present Volume, and see no reason for reviving it. The solutions of G. I. Y. and Mr. Russel are both very accurate, and we regret they did not reach us sooner.

Part LXXXII. for November, containing Six Numbers, with the separate Engraving on Stone of " The Rocket," " Novelty," and " Sans Pareil," is now ready.

Communications received from Mr. Woollgar—T. V. E.—G. S.—Eliza—Mr. Davy—G. P.—Algebraicus.—D. Y. R.—P. T.—J. D.

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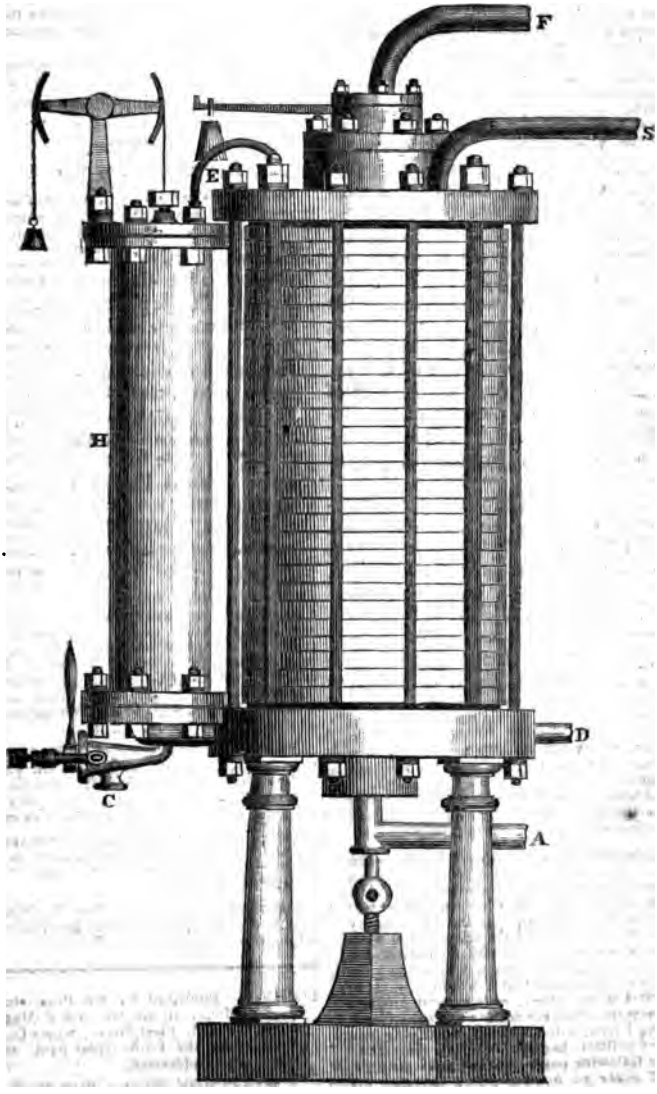
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 330.] SATURDAY, DECEMBER 5, 1829. [Price 3*d*.

GILMAN'S STEAM GENERATOR.

Fig. 1.



ON THE PROMOTION OF COMBUSTION BY FORCING AIR THROUGH FIRE, AND THE ECONOMICAL APPLICATION OF THE HEAT THUS PRODUCED TO THE GENERATION OF STEAM. BY MR. WILLIAM GILMAN, CIVIL ENGINEER.

In 1826, my attention was directed to the best and most economical method of generating steam, with a view to the improvement of steam navigation, and to other applications where economy and weight are the chief obstacles to the adoption of steam power.

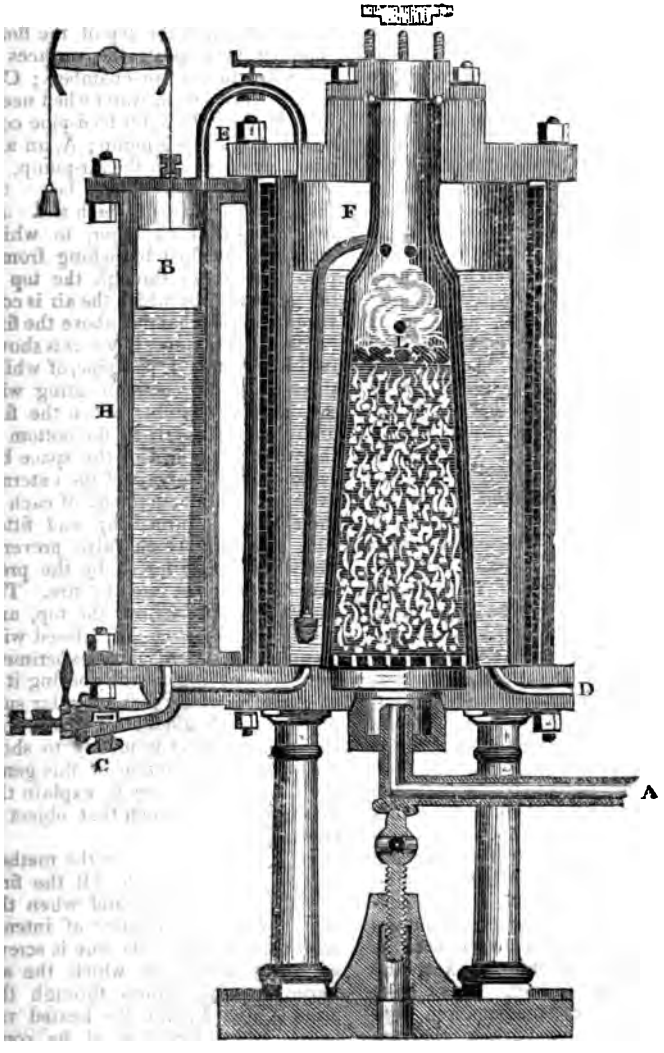
In that year the apparatus exhibited by the accompanying drawings was executed, and is now in existence. It was designed to prove practically the advantage to be derived from supplying fire with air by means of air-pumps, or other adequate means; and also from various applications of the products of combustion to the production of steam. The drawing, Fig. 1, represents the external appearance, and Fig. 2, a section of the apparatus or generator, which was of great strength on account of the various and sometimes great pressures—from 2 to 300lbs. per inch—employed in experimenting.

The generator consists of an internal and external cylinder of cast-iron, each of one inch thick. The internal cylinder, or more properly chamber, containing the fuel, is 18 inches diameter at bottom, whence it tapers upwards to near the surface of the water, where it is reduced more abruptly, and then continued of 8 inches diameter to its termination. The external cylinder is covered with two coats of wrought-iron hoops, each hoop half an inch thick by 2 inches wide, and put on red-hot: thus forming a compact body of metal of 2 inches thick; viz. 1 inch of cast and 1 inch of wrought-iron. The ends or bottom and top of the generator are secured by 12 long bolts, as seen in the drawings, in order to keep the joints perfectly sound. These bolts are made of very tenacious iron, and of a calculated strength to elongate or stretch by a force very much less than would burst the generator. Safety was thus secured *at any pressure; for the* moment the power of the steam becomes too great for the strength of the bolt-rods, a small elongation ensues, when the top of the generator is instantly converted into an immense safety-valve—being 2 feet in diameter—and the generator as instantly relieved. The small cylinder H, Fig. 2, is merely for the float B to work in; E, a small pipe to convey steam to the top of the float-chamber to equalise the surfaces of the water in the two chambers; C, a cock to draw off the water when needful; D, the cold water feed-pipe connected to a forcing-pump; A, an air-pipe connected with the air-pump, by which the air is introduced below the fire; L, an orifice, of which there are two opposite each other, to which pipes are attached branching from a pipe that passes through the top of the generator, by which the air is conveyed into the chamber above the fire. Neither of these pipes however is shown in the drawing. E is a pipe, of which there are four communicating with the internal chamber above the fire, and dropping nearly to the bottom of the water contained in the space between such chamber and the external cylinder. The bottom end of each of these pipes is turned up and fitted with a valve; which valve prevents the water being forced by the pressure of the steam into the fire. The fuel is dropped in from the top, and the opening occasionally closed with a cap—a mere temporary experiment however—as in constant working it is of course necessary that a regular supply of fuel should be admitted. As the present object is merely to show the principle of action of this generator, it is unnecessary to explain the arrangement by which that object is effected.

In using this generator the method of operating is first to fill the fire-chamber full of fuel, and when the fuel has acquired a state of intense ignition, the cap of the flue is screwed firmly down; on which the air forced by the pumps through the pipes A and L, and the heated vapours, gases, &c., formed by combustion, acquire density in the fire-chamber, and when of sufficient power to overcome the pressure of the steam generated in the space between

such chamber and external cylinder, the valves at the bottom of the four pipes F are lifted, and the products of combustion begin to flow regularly into the water, and will continue to do so as long as the pumps supply the fire with air. Hence none of the heat evolved can possibly escape without passing through the water and being turned to profitable account.

Fig. 2.



The elastic fluid thus formed being a compound of gases and vapours, is of course not wholly condensible, and therefore only *fitted for high-pressure* engines: but the great strength of the above-described generator will probably seldom be required, as riveted plates are sufficiently secure for most

purposes; nor need the same form be followed.

With respect to combustion *under great pressure*, I have never discovered but that it proceeded as well in that way as by common drafts under the ordinary atmospheric pressure As to the expense of *power* required to force the air, I may observe, that that part of the atmospheric air—nitrogen—which does not enter into combustion, but separates itself from the oxygen during the process, though it does not itself evolve heat, must of necessity become charged with a considerable portion of heat in passing through any fire. Now, while in fires worked by a common chimney-draft the nitrogen thus charged with heat is almost wholly carried into the atmosphere and lost—in passing through a close fire and into the water in the manner before-mentioned, it must ultimately pass through the engine, in consequence of this charge of heat, with greater elasticity and power than the resistance it could oppose while being forced. Hence there is at least a favourable preponderance.

Then as to the oxygen, we will suppose (leaving out other products formed by combustion, for the sake of simplicity) that every 659 cubic feet of oxygen forced into the fire unites with 1355 cubical feet of hydrogen—the composition of one cubic foot of water. Now the 1355 feet of hydrogen is derived entirely from the fuel, and the foot of water so formed, or rather vapour, will be equal to about 1800 cubic feet at atmospheric pressure—for a cubic foot of water converted into steam at that pressure expands about 1800 times. Hence we have an increase of more than $\frac{1}{4}$, or nearly two-thirds over and above the oxygen forced into the fire, and equal to one-fourth of the whole volume of atmospheric air necessary to supply the 659 cubic feet of oxygen gas, as a compensation for friction, &c., in forcing.

From the foregoing short description it is manifest that no more room need be occupied by a generator on this principle than what is absolutely *necessary* to the combustion of an *adequate quantity* of fuel, and the small space of a few inches to surround the fire with water and to form a steam-chamber. The four pipes F, instead of being attached to the fire-chamber *above* the fire, should be affixed about the *middle* of the burning mass.

Other modifications bearing strongly on the above principle were embraced in the general plan, and some of them put in practice. One was an application of air to the fire in the manner above-described; but instead of the products of combustion being forced directly into the surrounding water of the generator through the pipes F, it passed through a flue-pipe attached to the cap for that purpose, as seen in figure 1, into a separate vessel, under a much lower pressure than the steam formed in the generator, by which the heat was absorbed, and the water thus partially heated transferred to the generator to make good the evaporation. Another mode tried was to have air forced into the close fire of a steam-boiler, having a sufficient length of flue to absorb the heat as in the usual manner, which flue terminated by descending into a cistern of water; the depth of the end of the flue below the surface being the gauge of the density of the products of combustion in the flue, which density might be increased or diminished at pleasure, as circumstances required. This method prevents the products from expanding with so great rapidity, and the heat becoming latent therein. Hence there will be more free heat given to the surface of the flue and absorbed by the water in contact therewith. The water in which the flue terminates will absorb the remaining heat, condense the vapours, and detain all carbonacious and other ponderous matter—while the gases will escape from the surface, and that nuisance, a chimney, be dispensed with.

The last modification which I shall now notice is the application of an exhausting-apparatus over the surface of the water in which the flue terminates, instead of forcing the air into the fire; by this means a partial vacuum is formed above the surface of the water equal to any required draught, and the water absorbing the

heat of the flue, &c., as in the last modification, no injury to the exhausting-machine can ensue, and the chimney is also dispensed with. A drawing of this plan was made and presented to some gentlemen in 1826.

[To be concluded in our next, when we shall offer some remarks on the obvious similarity between Mr. Gilman's plans and those of Messrs. Braithwaite and Ericsson.—EDIT.]

ON PREVENTING THE WARPING OF SMALL FILES IN HARDENING.

Sir,—In No. 320 of your Magazine, I find your correspondent "C. C." wishes to be made acquainted with "the method which file-makers adopt to prevent the warping of their small files in hardening." For this reason, I send you a few hints; and should "C. C." find them useful, and make the result of his experiment known through the medium of your valuable work, he will by so doing "confer an obligation" on me; as I am of the opinion, and perfectly agree with Mr. Mackinnon, your correspondent in No. 316, wherein he states that to be master of the above art "requires experience, and cannot be taught by written directions."

First, forge your steel plates to the size required, after which they must be softened, thus:—Take a quantity of wood chips, and having heated your plates hot enough to set them on fire, let them be placed thereon, and remain there until the whole of the chips are consumed, and the plates cool. Your plates must now be filed perfectly level for cutting; and the same method must be resorted to in files which require to be re-cut. When they are cut, they should be placed in a mixture of lime and water, of moderate thickness, in which they may remain for any length of time, or till you wish to harden them; they will not rust, or take any hurt, by lying in this solution, the lime being a preventive.

When you feel inclined to harden them, they must be taken out of the mixture, and placed directly before a good fire, to dry the lime, which will fill up the cavity between the teeth, and is only used to prevent the fire from destroying the same during the process of hardening. You must now have in readiness a tub, containing three pailsful of spring-water, into which you may place the following ingredients:—

8 oz. of sal-ammoniac, powdered;
8 oz. of aqua-fortis;
1 lb. of common salt:

which water may be kept for hardening some time. You must also have at hand a wooden mallet and block, in case of your file coming in contact with a piece of coke, &c. while getting your heat, and causing the same to bend; in which case you must lay your file upon the block, and gently press the crooked part with the mallet until you have made it perfectly straight. It is farther necessary to have a flat box, containing 1 lb. of common salt, in which you must rub your file every time you take it out of the fire to ascertain your heat. Having all these requisites prepared, then blow up a good loose fire, free from gas or green coal; and when you have got a good red heat, hold your file as perpendicularly as you possibly can over the water, and sink it gradually, in the like position, into the same as far as the tang, or handle, which must not be hardened.

By this process you are likely to harden many files at the first attempt; yet sometimes you cannot prevent some from warping. If any of them should do so, they can be remedied thus:—Put a quantity of grease or oil into a long flat pan, into which place the files which are warped; then heat a piece of iron red-hot, which place in a vice, and take one of the warped files out of the oil-pan, and fasten a hand-vice at each end to hold it by; then humour the same backwards and forwards, according to the warping, which will presently come straight, taking care to keep plenty of oil upon your file, which preserves the temper of the steel, and prevents the heat of the iron from softening it. This done, nothing remains to be observed but cleaning.

Place your files into a pail of warm water; then take a hard brush, on which place a little soap, and brush them till all the lime which still remains between the teeth is completely washed out; then place them directly be-

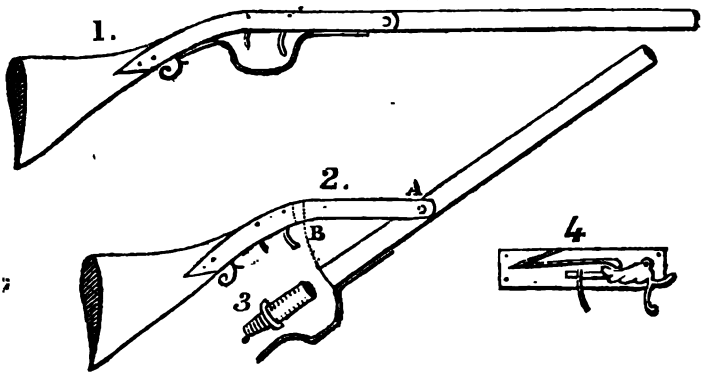
fore a good fire to dry, and brush them again with a dry brush. Finally, take a small quantity of the best oil, and drop a little on a soft brush, and rub them all over with the same, taking care to let the files be a little warm, which will cause the oil to spread more thinly over them. They are now in a fit state to be laid by till wanted for use.

This, Sir, is all the information I can give your correspondent respecting this matter. But, before I conclude, I should advise him to forge out a few pieces of steel to the dimensions required, and let him practise hardening the same, till he is somewhat perfect; by which means he will save a quantity of files which he might otherwise spoil.

I remain, Sir,
Your most obedient servant,
R. DANIEL.

Eldon-street, Finsbury Circus,
Nov. 7, 1829.

BREECH-LOADING GUN.



Sir,—To those interested in the use of fire-arms, I hope no apology is necessary for occupying a page of your excellent Magazine with descriptions of an invention which may tend to accomplish that great desideratum—the loading at the breech. The prefixed sketches were taken from a gun which I constructed, and found to answer very well.

Before entering on a description of the different parts of the said invention, I beg leave to observe, I am far from concluding myself arrived at the *ne plus ultra* of breech-loading, as I confidently look forward, through the medium of your widely-circulating work, for great assistance from the liberal mechanic.

Fig. 1, represents the gun complete. Fig. 2, the barrel turned down for the purpose of loading, by pulling the guard, which opening *from a latch* affixed to the scroll, allows the barrel to turn on the trunnions, as shown at A. Fig. 3, the charger, having a patent breech, into which the cartridge is put, the cylinder of which fits accurately into the calibre of the barrel. For military purposes this charger can be dispensed with, when by means of a sharp edge attached to the under part of the false breech at B, the cartridge being inserted ball foremost into the lower orifice of the barrel, will have its end bitten off on closing the gun; thus exposing the powder to the fire from a touch-hole bored through the false breech, which is firmly rivetted between the cheeks of the iron stock, the butt alone of which is composed of wood. Fig. 4, the lock, wherein the usual order of the cock and mainspring has been reversed.

The many advantages of such an arrangement must be apparent to all who are habituated to the use of fire-arms. Security is hereby obtained from rain; the eyes are shielded from

the flying fragments of copper caps; and accidental strokes from foreign bodies, whereby many fatal explosions have occurred, are prevented from falling on the pillar. These are the principal features of an invention which I trust will command the attention of the ingenious mechanic, with whom I should be happy at all times to unite in efforts at improvement.

J. W.

Tullamoore, Sept. 2, 1829.

DESCRIPTION OF A MACHINE FOR PRESSING BOOKS BY ROLLING INSTEAD OF HAMMERING.

Sir,—Observing in No. 317, of your instructive miscellany, a notice of an improved book-binder's hydrostatic press, by Alfred Holden, it recalled to my recollection a press, which, in my opinion, answers the purpose better; and were it more generally used, would entirely supersede the old, laborious, and imperfect method of beating books with hammers, the blows of which, suddenly compressing the air between the leaves, create a heat, which is liable to make the printing set-off (as it is termed) on the opposite pages.

The press consists of two iron cylinders, about a foot in diameter, adjustible in the usual way by means of a screw, and put in motion by the power of one or two men applied to a cranked handle. In front sits a boy, who gathers the sheets into packets, by placing two, three, or four, upon a piece of tin plate, of the same size, and covering them with another piece of tin plate; and thus proceeding, alternating tin plates and bundles of sheets, till a sufficient quantity has been put together, which will depend upon the stiffness and thickness of the paper. The packet is then passed between the rollers, and is received by the man who turns the winch, and who has time to lay the sheets on one side and hand over the tin plates, by the time the boy has prepared a second packet. I have seen by means of this press, a minion Bible pressed ready for binding in *one minute*, whereas the *time necessary* to beat the same would have been twenty minutes. But it is not merely a saving of time that is gained by the use of the rolling-press; the paper is made much smoother than it would have been by beating, and the compression is so much greater, that a rolled book will be reduced to about five-sixths of the thickness of the same book beaten: so that a shelf that would hold fifty books bound on the old plan, will hold nearly sixty if passed through the rolling-press. I will merely add, that the expense of the machine is but trifling compared with the advantages derived from the work being better finished, and the saving of men's time in beating them.

I remain, Sir,

Your obedient servant,

BRACKSTONE.

EXTRACTS FROM MY NOTE-BOOK.

No. 3.

Optical Phenomenon.

"C." (vol. xi. page 31) will find an answer to his inquiry in the "London Encyclopedia," art. *Optics*. The passage is long, or I would transcribe it.

On the Infinite Divisibility of Matter.

"The fourth property of matter," says Ferguson, ("Lectures," p. 3.) "is *divisibility*, of which there can be no end. For since matter can never be annihilated by cutting or breaking, we can never imagine it to be cut into such small particles, but that if one of them be laid on a table, the uppermost side of it will be farther from the table than the undermost side." Our author then shows how matter is infinitely divisible in a "mathematical sense." On this passage, Dr. Brewster justly observes, "The above reasoning is merely ideal, and only shows that we can conceive *extension* to be infinitely divisible."

The Doctor's remark would have been more just, if he had said that the reasoning was *misplaced*.

In all cases of *division* or *separation*, the attraction of aggregation or cohesion is overcome: this, therefore, ought to be taken into consideration in any proposed proof of the *infinite* divisibility of matter; and unless this

is done, we may justly refuse our assent to this doctrine, for it is a sufficient ground for dissent to show the invalidity of the reasoning by which it is supported. Physical writers in their pretended proofs of infinite divisibility have advanced arguments which bear upon *extension* only, and not upon *matter*; I therefore beg the advocates of infinite divisibility to prove it by arguments in which the attraction of aggregation is considered, or else to discard it from their philosophical creed, and be in future guided more by the principles of common sense than the *dicta* of philosophers.

On the Co-existence of Cause and Effect.

"Now, to continue an *effect*, the producing *cause* must continue its energy. The *stream* from the *fountain* will not continue to flow, unless the fountain itself supply the requisite quantum of *water*. All effects depend on their causes: so that when the *cause ceases to act*, the *effect ceases to exist*."—Dr. A. Clarke.

The opinion that cause and effect are co-existent is so evidently opposed to fact, that I am surprised to find it advanced by so talented a writer as Dr. Clarke. I write: the letters and words I form will remain in existence after I have ceased to write. An injury done will excite anger: the anger continues after the commission of the injury. I throw a ball from my hand: the motion of the ball *(the effect)* continues after the motion of my hand *(the cause)* has ceased.

In short, this opinion is completely incompatible with *succession of event*, unless we suppose that *events* are *independent* of each other. But if we admit this, we deny *causation*, so that this opinion destroys its own foundation.

If the subject of causation is not too metaphysical for your readers, I may perhaps in some future communication show that every *effect* is the result of *two* causes.

On the absolute Zero.

(*See page* 173*)

I was wrong in charging MM. Dulong and Petit with placing the absolute zero at −448° Fahr. I should have said, MM. Clement and Desormes. Dulong and Petit have been led by their investigations to fix it at infinity.—See "Ure's Dictionary," art. *Caloric.*

(To be continued.)

* Your printer omitted the minus sign before 448° F.

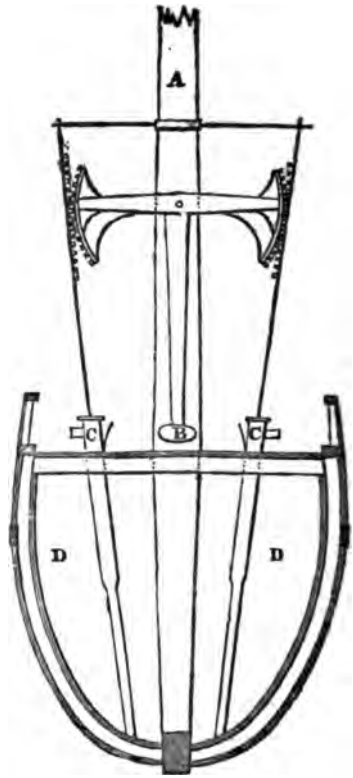
PLAN FOR WORKING SHIPS' PUMPS.

Sir,—I herewith hand you a plan which has flashed across my mind, for working ships' pumps by means of a pendulum; which I trust ultimately may prove useful, when in the hands of men possessing more nautical science than I have any pretensions to. By giving it a place in your valuable publication, you will oblige,

Sir, your obedient servant,

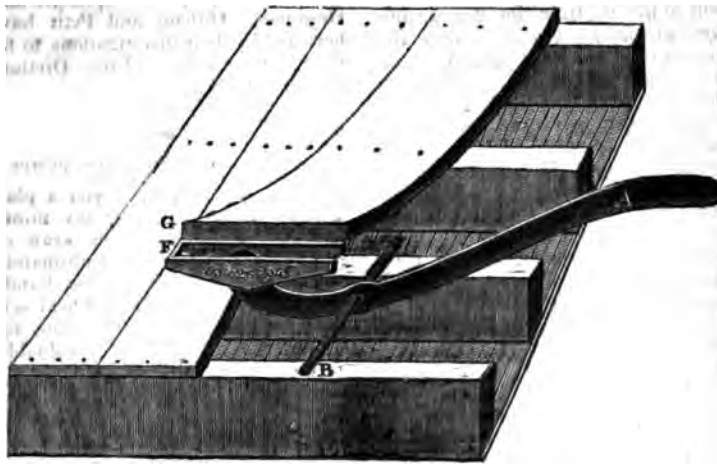
G. P.

Sutton Wash, Sept. 28, 1829.



Description.

A is the mainmast. B pendulum. C pumps. D ship's hold.



FLOORING-LEVER.

Sir,—In vol. x. p. 145, you have given a plan of a flooring-cramp; I now send you a plan of a lever for taking up flooring, and which will be found to answer well for many other purposes. A is the lever; B the bolt that rests on the joists, that give the power to the lever; C the lifter, which moves on a bolt at 2, by which means the lifter is always close to the board, and not pressing more at one part than another, but in all parts alike, so that it is not possible the board can be split or broken. The nails must either draw through the boards or out of the joists. There are three places for the bolt to pass through the lifter C, as 1, 2, 4; so as to make the lever end always be in the centre of the board, and F always to be fair with G. I have taken away part of the board, for the purpose of showing the apparatus more clearly.

I remain yours, &c.

M. SAUL.

Sulyard-street, Lancaster,
August 18, 1825.

VIBRATION OF PENDULUMS.

Mr. Editor,—On looking over the "Library of Useful Knowledge" under the head Mechanics, I do not find the subject of pendulums yet treated of; probably from a supposition that the exposition of the principles on which their action is founded, would require the aid of a greater portion of mathematical knowledge than is supposed to be possessed by the generality of readers, for whom that work is intended.

As your excellent publication is destined for students of a higher class, permit me, through the medium of your columns, to ask a question on a subject which though treated of by many of the writers on fluxions, the solution given by them is in my opinion not quite so intelligible as could be wished.

This question—which forms the 106th Problem in Dealtry's Fluxions, and the 335th Institute of Martin—is this, What is the ratio between the time of vibration of a pendulum through an infinitely small arc of a circle, and through the entire semicircle?

In order to simplify the matter, let us take the case of a single pendulum, which is supposed to be an inflexible right line devoid of gravity, bearing at its lowest extremity a weight of no sensible magnitude, which, in order to vibrate seconds in the latitude of London, ought to be of the length 39·13929 inches.

If the time of its vibration through an infinitely small arc of a circle be denoted by unity, then, according to my solution, 1·16666, &c. *ad infin.* (or one second and a sixth), must be the time of vibration through the entire semicircle.

Any of your scientific correspondents who can set me right in this respect, will oblige your constant reader and subscriber,

INQUISITOR.

Nov. 16, 1829.

THE ALMANACS FOR 1830.

(Concluding Notice.)

After devoting so much space to the merits of the *New* Almanacs, we should be guilty of a disrespect, which we are far from entertaining, for our older favorites in this department, were we to take our leave of the subject, without bestowing upon them a few words of remembrance.

WHITE'S is still the best ephemeris published: not even excepting that notable government job, "The Nautical Almanac." It contains several most desirable and essential things, which the government work (much to its disgrace, and not a little to the injury of our maritime interests,) does not contain. We allude particularly to White's tide tables of unrivalled accuracy, to its ephemerides of the new planets, Vesta, Juno, Pallas, and Ceres—the aspects of which are given for every sixth day in the year; and to a table of the eclipses of Jupiter's first satellite, by means of which, and the help of a telescope, navigators may ascertain the longitude with singular ease, at all times when Jupiter is 8° above the horizon. In order to enhance the value of this ephemeris, and make it more worth preserving in sets, the learned editor has recently adopted the judicious plan of giving every year some two or three pages of *quite* new tables and formulæ. One of the novelties for the next year, we consider to be particularly curious and valuable. It is a table under the head of "Degrees and Pendulums," showing the length of a degree of longitude and a degree of latitude at every five degrees of latitude, together with the lengths of a seconds' pendulum, at those latitudes respectively; and also the increase in the number of vibrations *per diem* of an invariable pendulum, that beats seconds at the equator on being carried towards either pole. The measures at the equator are here considered as unity; for example, the length of a degree of longitude is supposed to be 100,000 at the equator; at 5°·99622; at 50°·64404; and so on; but we think the table would have been *more readily* comprehended, and of *course more* practically useful, if, instead of showing the comparative increases and decreases in relation to an ideal standard, it had taken for its basis the actual numbers assignable to the equator. Thus supposing a degree of longitude at the equator to be 69·15 miles, and that this had been adopted as the standard of comparison, it would have been at once seen by inspection of the table, what is the actual comparative length of a degree at 20°, 50°, 60°, or any other latitude. The computation to be sure is easy, but so also it would have been to make any computation unnecessary.

THE LADY'S AND GENTLEMAN'S DIARIES will be found, as usual, an odd compound of excellence and (must we say it?) frivolity. Dear they certainly are to philosophy, for the services they have rendered, "in creating and fostering a love of science in some of the highest mathematicians and astronomers of this country;" but dear also to riddle-me-ree-ism, for preserving, amid the devastations of modern intelligence, a sacred corner, where pedants in petticoats and wiseacres in wigs may puzzle each other to admiration, about the veriest nothings—where all sorts of silly

> "*Maggots*, half-formed in rhyme exactly meet,
> And learn to crawl upon poetic feet."

The worthy "Company of Stationers" have dropped a hint in reference to these almanacs about the propriety of "supplying innocent employment for the ingenious."—"*Innocent* employment!" and for "the *ingenious*" too!! We must be permitted to doubt, in the first place, whether any appropriation of time, to what is not *useful*, *can* be *innocent*; and, secondly, whether any truly "ingenious" person would think of resorting, in the way of *useful* (the only allowable sort of) recreation, to the solution of such problems as:

> "My first is a B,
> My second not I,
> Third plain as B C,
> My whole on the banks of—
> The Wye."

We have not copied this rebus from either the *Lady's* Diary or the *Gentleman's*, but we give it at the request of a young lady at our elbow, as being quite as useful, if not as soul-inspired, as any thing of the kind to be found in either publication. Could not Messrs. the Company of Stationers venture to bring this reign of verbiage to an end? Are they aware that it rests with them entirely? One other publication there is, we believe, which delighteth in what is "enigmatical;" but let every thing of the sort be once excluded from the "Lady's and Gentleman's Diaries," and

it would henceforth cease to be respectable.

"FRANCIS MOORE, PHYSICIAN!" most popular and *oldest* of *living* authors!—Whence thy unrivalled popularity?—Whence thy antediluvian length of years? There are those who say that "Francis Moore, physician," is and ever has been a great quack; that he has lived and flourished by cozening and cajoling the simple people of this country, generation after generation; that even his living so long is all a trick; and that he should have been dead and buried years ago, under a mountain of his own lying prophecies. Nay, so bitter is their hate, that they have actually banded together and subscribed purses to *compel* the poor man, *nolens volens*, to give up the ghost. Yet, strange to say, in spite of all that has been said and done, to open the eyes of the people and stop the mouth of their "deluder," the redoubtable "Francis" still liveth, and still exhibits every symptom of a green old age. His patients (dupes they are called) are said to be as numerous a multitude as ever—not just a round million, but somewhere thereabouts. Can it be possible, our "physician" is the vile quack he is called, and yet maintain so fast a hold on the affections of the people? We do *not* think it possible. It is not in the nature of things that sheer imposture should so triumph and endure. The quackery of Francis Moore must have long ere this succumbed to some other and newer quackery; for the love of folly ever hunteth after novelty. We are well satisfied it can only have been by the force of much rare and sterling worth, that his "Loyal Almanac" has seen such a length of days. In what that worth consists, and by what demerits it is clouded, we took some pains to show last year; and succeeded, we trust, in demonstrating to the satisfaction of many, that to join in the outcry which has been lately raised against him, would be to lend our aid to make a few trivial faults, weigh heavier in the balance, than a world of useful service. His predictions, relating to the weather and other "mundane affairs," his annual "Hieroglyphics," and his "Astrological Judgments," are all doubtless very foolish things, though perhaps more to be laughed at than cared for. Vain as all pretension to a foreknowledge of events is, there is a feature in the prophesyings of Francis Moore which we consider to be of very extenuating description. We allude to the ardent desire which they uniformly breathe for the spread of *knowledge, liberty,* and happiness; a desire which *may* have done good by helping to give a tone to public feeling, and cannot possibly have done harm. In one of the latest tirades which we have seen against this almanac, it is asked, "Would a copy of 'Moore' be bought if people did not yet believe in it?" We apprehend that if "Moore" was only to be bought by those who literally *believe* in him, there would be soon an end of "Moore," and all dispute about him; but, supposing he had as many implicit believers as his revilers pretend, it must surely be a source of great consolation to know that they are rarely, if ever, asked to believe (of political matters) what it would not be much to their benefit, and to the benefit of all mankind to see realized. Be the effect of "Moore's" prophecies, however, what it may—suppose there were not a word of prophecy in his book—we still maintain that there is merit enough in the other matters with which he annually supplies us—matter choice and useful beyond all dispute—to make him be universally sought after *on account of that other matter alone.* Had there been no "Moore" this year (which would have been according to the wishes of some people), we should like to know where we could have found such full, correct, and popular accounts, as are furnished by "Moore," of the various celestial phenomena for the year 1830? Not certainly in "The British," which was put forward as the grand substitute for "Moore," but is miserably deficient in astronomical information; nor even in the much superior "Englishman."—"Moore" gives two articles this year—one under the head of "An Account of the Eclipses of the Sun and Moon," and the other entitled, "An Account of the most remarkable Lunar Occultations, Appulses, and other Celestial Configurations," which are alone worth the whole price of the Almanac; and leave at an immeasurable distance every thing of an astronomical description which the members of the Society for the Diffusion of Useful Knowledge have yet been able to supply.

In the first of the articles we have just alluded to, there is an interesting fact mentioned with respect to a total eclipse of the moon on the 2nd of September next, which we do not see noticed in any of the other almanacs; or, at least, only obscurely hinted at. It is said that, "at Greenwich, the moon will, from the effects of her parallax, appear a few minutes south of the fixed star λ ♒ during the eclipse; and to lower latitudes this conjunction will prove an occul-

tation, at the time when the moon is immersed in the shadow of the earth. The nearest approach of the moon's northern limb to the star, as seen from the Royal Observatory, will be 9′ 54″; this happens at 9h. 24m. 24s. or 23m. 27s. before she is totally obscured."

One thing there is in "Moore" which we are sincerely sorry to see still associated with so much excellence. We allude to the column appropriated to the "Dominion of the Moon in Man's body." It is not merely foolish—it is an utter abomination. The Stationers' Company say that the astrological predictions of "Moore" "deceive nobody," and serve only to *amuse*. But can they say the same thing of his "Moon's Dominion?" If it is not intended that people should have faith in it, for what is it worth?

The observations which we have made with respect to Moore will apply, more or less, to his fellow-soothsayer, PARTRIDGE, in whom the same faults and the same compensating excellences are observable.

MOORE'S IMPROVED, might, we think, be more *improved*; but, to all country persons, who have a horror of astrology, and no particular regard for astronomical matters—who seek only to know how they may raise the best crops, rear the fattest cattle, and find the likeliest markets—this almanac will prove a useful companion.

GOLDSMITH'S, though but a waistcoat-pocket almanac, possesses merits which have been strangely (conveniently perhaps) overlooked in the denunciations of the Useful Knowledge Society. It has been published for about half a century, and contains a vast variety of matter of general interest, wholly free from any astrological intermixture whatever. It was almost as good an almanac as "The British," long before "The British" appeared, and is now but little inferior to it in point of useful information.

The COUNTY SHEET ALMANACS, of which eight are published annually by the Stationers' Company, are deserving of favourable notice for the great quantity of local information which they respectively embrace; but of notice also, of a different description, for exhibiting the same sort of abomination which we have just reprobated in "Moore." The "Dominion of the Moon" in "knees, arms, legs, ancles, feet, toes," &c.! What is it but an insult to the intelligence of the age to persist in such absurd conceits?

After all, we fear it must be *confessed that, though* there is undoubtedly a marked spirit of improvement pervading all the Company's almanacs, it is a spirit of rather of a timorous cast; well-disposed towards such improvements as come in the shape of additions, (to giving, for example, a "Moore Improved," rather an "Improved Moore,") but shrinking from every thing in the nature of absolute alteration or change. The Company seem to be too much under the influence of a notion that it is their duty to provide almanacs for all sorts of palates, and that there is nothing so weak or foolish which will not please some class or other. We do not dispute that

> "By some object every brain is stirred:
> The dull may waken to a humming-bird;
> The most recluse, discreetly opened, find
> Congenial matter in the cockle kind."

But, if we recollect rightly, this was an observation addressed by the Goddess of Dulness to her children, among whom we are far from ranking so active and intelligent a body as the members of "The Stationers' Company." If the Company would but authorise and direct the pruning-hook to be used a little more unsparingly, they might at once place their almanacs as much above competition as reproach. In every essential particular they are unrivalled; it is certain grotesque excrescences only which want to be lopped off. Nearly all that science can do for them has been already done; nor of all the faults which we have pointed out, is there more than one or two, which is not obviously to be referred to the operation of circumstances and usages, not subjected to the control of the highly-gifted and eminent individual, to whom their scientific superintendence has been intrusted.

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

(Continued from p. 223.)

Attraction of gravitation is a particular instance of a general effect: the denomination "attraction" being the name for a class of effects, the leading feature of which is, that if two bodies are placed near each other, they will move towards each other and along a straight line supposed to join them. The strict and philosophical meaning of attraction is not required in mechanics: in this science the fact only is to be observed, viz. that the bodies approach each other. There is a cause which produces this effect,

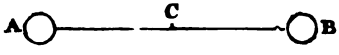
but it is not the object of this science to investigate that cause—it is sufficient for the knowledge of mechanics that the effect *is* produced. Consequently, by "attraction" is to be understood that one body moves towards another, and by repulsion that one body moves from or is repelled by the other; the language of effects and not of causation being used.

Attraction is reduced into several classes, each having peculiar or specific properties, as magnetic attraction, electric attraction, &c. all of which form the foundations of distinct sciences; but the only one now to be considered, is the attraction of gravitation, which is found to exist in every thing, whether solid, liquid, or gas.

The first thing to be considered, with regard to gravity, is its law; viz.

If two equal masses of matter be placed near each other, and no force exerted to keep them in their places, they will move towards each other and along a straight line supposed to join them, and they will meet at a point equidistant between them. Thus let A and B be the two masses

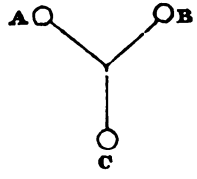
Fig. 1.



beyond the influence of all other bodies; they will move along the straight line A B, and will meet at a point C, midway between the two. And this effect will ensue, whatever the quality of the masses may be. But in what proportion will these consequences ensue? The force with which the two masses are found to attract each other, *decreases* in the same proportion * as the square of the distance between them. Let the distance be equal to 1, and let the force be equal to 2. Now, if the distance be increased to 4, the force will decrease in the same proportion as (or, what is the same thing, will be in the inverse proportion to) the square of the distance between them: therefore, as $1:2::(4^2)\,16:\frac{1}{2}$, which will be the force of attraction. In the same manner, if the distance be 3, the force will be $=\frac{1}{4}$ if $2=\frac{1}{2}$, &c. This is the general law of gravity; and it is by this law that the planets are kept in their course round the sun. It may be asked, what is the difference between this kind of attraction and any other species? The difference is, that the former is an universal property, which the others are not.

The last rule applied only to equal masses, but let us now suppose them to be unequal. Let A be one

Fig. 2.

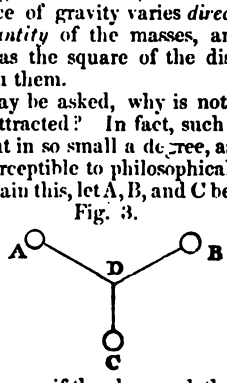


mass, and B and C be two others, each equal to A. Now they each exert the same degree of attraction as A; but if they be incorporated, their effect is not changed, but the single mass will then possess double the attraction that is possessed by A: thus the attractive power is increased in the *same* proportion as the size.

The general rule is, therefore, that the force of gravity varies *directly* as the *quantity* of the masses, and *inversely* as the square of the distance between them.

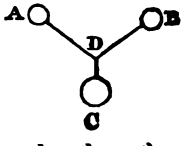
It may be asked, why is not *every* thing attracted? In fact, such is the case, but in so small a degree, as to be only perceptible to philosophical tests. To explain this, let A, B, and C be three

Fig. 3.



bodies: now, if they be equal, they will all meet in the central point D. But suppose one of these bodies, C, be

Fig. 4.

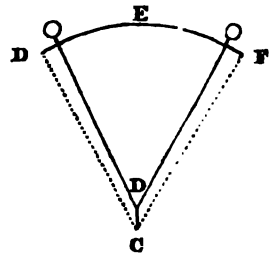


larger than the others, then the point

* This proportion is the same both in magnetic and electric attraction.

D, at which they meet, is nearer that body than the others. Again, let

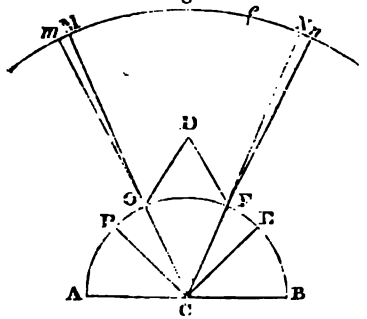
Fig. 5.



DEF be an arch, representing the surface of the earth, of which the centre of attraction is C, and let A and B be two bodies situated near the surface, it is evident that, from the point at which they will meet (D) being so near the centre C, the two bodies will have but little sensible motion towards each other.

There are some phenomena of this property which are, however, manifest. For instance, a weight being suspended near a mountain from a fixed point, was found to be attracted by the mountain, and consequently to deviate from the perpendicular. This experiment was made on a mountain called Chimborazo, and was done in the following ingenious

Fig. 6.



manner: Let A O F B represent the surface of the earth, of which C is the centre, and O F the base of a mountain O D F.* Let *e* represent the position of a star in the arch of the heavens, the place of which is accurately known by astronomical means. Lastly, let E C represent part of the equator, and P be the North Pole. The first experiment was made on the side F of the mountain, and the distance was found from the star *e* to *n*: a place at which a line continued in the direction of the string by which the weight was suspended, would reach the arch M *e* N. The experiment was then repeated on the other side O, and the distance found between a point *m* and the same star *e*. But these two distances, when added together, were found to be greater than an arch, M N, of the same number of degrees as the base, O F, of the mountain: the half of the surplus then gives the variation from the perpendicular, on account of the attraction of the mountain, which, in the above experiment, was found to be 9 seconds.

There are some instances, however, in which the earth seems to possess properties exactly opposite to the last; viz. it seems to repel some bodies, or to drive them away from its surface. A balloon, for instance, when filled with gas is found to rise, instead of being attracted towards the earth: this ascent is precisely analogous to that of a cork in water, and is, on account of its being bulk for bulk, lighter than common air, as the latter is in the same way lighter than water. The attraction in gas may be proved by weighing it, as may also that of common air.

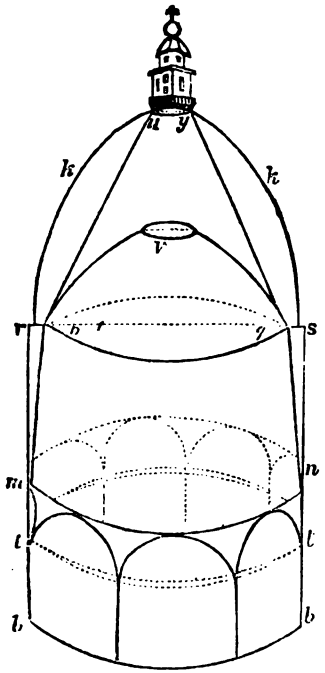
Gravity subsists not only in every mass, but also in every particle of a body. Let there be one particle of matter imagined which is attracted in a certain degree, now a second particle would receive an action independent of the first, and they would fall together. A heavy body falls with a greater velocity than one that is lighter: for, on account of the resistance of the air, the velocity depending on the horizontal surface of the body, which may be proved thus —If a piece of metal be let drop from any place at the same time, with a feather or other light body, it is well known that the metal will reach the ground considerably sooner than the feather will; but if the experiment be made in the exhausted receiver of an air-pump, they will both reach the

* The mountain is here drawn in a much larger proportion to the earth *than it really is*, but it shows the effect *in a greater degree*.

bottom at the same time: thereby clearly proving that it is the resistance of the air which causes the bodies to descend with different velocities.

(To be continued.)

ON DOME-VAULTING, AND THE CONSTRUCTION OF THE DOME OF ST. PAUL'S.



Sir,—Although I am not an architect, as this letter will probably show, yet I have long taken a deep interest in all that is connected with the theory and practice of architecture. I cannot but suspect that the theory of the equilibrium of domes is very imperfectly understood, even by architects themselves (except a few who are men of real science); and I was greatly strengthened in this suspicion by the crude comparisons which were made some time ago, in many of our periodicals, between the walls of the Brunswick Theatre and the brick cone which supports the cupola of St. Paul's. The thrusts and pressures in the two cases are of a nature totally different; yet many persons reasoned from one case to the other, as though they were both alike.

Residing in the country, as I do, it is only now and then that I can get a peep at the noble metropolitan church; and when I can, it is not always that the kind of inquiries occur to me, which at other times I am anxious to make. My acquaintance with this crowning part of the structure is, therefore, incomplete. And, as I meet with many persons who know even less of it than I do, I have hoped that it would not be difficult to obtain more extensive and correct information both for them and myself through the medium of your valuable Magazine.

The exterior dome rests, by means of a framing of wood-work, upon a brick conic frustum, which also carries upon its top an immense stone lantern, globe, and cross. This brick conic frustum does not, as is usually imagined, rest upon a *cylinder*, of 110 or 112 feet diameter, but upon a structure of columns and windows, or elegant open-work masonry, of which the exterior perimeter is cylindrical, and the interior peristyle is another conic frustum, making a less angle with the vertical cylinder than the superposed brick frustum, and extending nearly from the base of the whispering-gallery to that of the stone-gallery.

The brick frustum is, I believe, of *two* bricks thick, and it has several chains or girdlings, some said to be of iron, some of brick, and one of stone, at uniform distances in its slant height.

From the top of the larger conic frustum and the bottom of the brick frustum springs the inner cupola, which is open at top; the *eye* (as it is called) being surrounded with another gallery, which is at about two-fifths of the vertical distance between the stone-gallery, and that above the exterior cupola usually denominated the golden-gallery.

But how is this immense and curiously-adjusted mass supported?

By *eight* very massy pillars, which are not so arranged as to occupy the angles of an equilateral octagon, but

those of an octagon of four longer and four shorter sides: this octangular arrangement being in a certain sense hidden by the contrivance of throwing the eight angles into the four sides (E. W. N. S.) of the central *quadrangle*; while, however, it is easily detected by the semicircular tops of the eight vaults which pierce the cylinder in which the octagon is inscribed.

The preceding brief description may, perhaps, be rendered more intelligible by the aid of the prefixed outline sketch, which, though it has no pretension to accuracy, may serve for illustration.

For the sake of more thoroughly comprehending this interesting structure, I beg to propose the following questions to such of your readers as are able, and will be so obliging as, to furnish the requisite information.

1. What is the diameter, *bb*, of the circle which bounds the octagon, and what are the sides of the octagon?

2. Does the foundation of the dome merely occupy the bases of the eight piers or pillars? Or, does it occupy the entire ring in which those bases are placed? Or, does it comprehend the area of the whole circle *bb*?

3. What are the dimensions of a horizontal section of each pier or pillar, and what is its height, *bt*, from the foundation to the springing of the semicircular arches?

4. What is the estimated weight of the whole structure above *tt*? How much of that is supposed borne by each pier? And what is the average pressure in tons sustained by each square foot of horizontal section of a pier?

5. What are the dimensions of the interior conic frustum, *mnrq*? What is the thickness, *rp*, *qs*? And what the angle of inclination, *snq*, with the vertical plane?

6. Is the interior cupola, *pqr*, hemispherical or not? What are its dimensions? And of what material is it built?

7. What are the dimensions of the brick conic frustum, *pquy*? How many bricks is it in thickness? How many girdlings or chains surround it? Are any of them mere iron chains? Are any of them of free-stone? Where *and how are they* placed, and what is *their precise* use?

8. What are the dimensions of the exterior cupola? Is it a hemispheroid, a conoid, or is its contour constituted of portions of circular arches?

9. What are the principal excellencies in this central structure of St. Paul's?

10. What are its chief defects? Which of them were original mistakes of Sir Christopher Wren; and which of them resulted from the interference of the Commissioners, which as it is generally understood, sadly annoyed this great man in the progress of his splendid undertaking?

Hoping that your Magazine will soon be the vehicle of some instructive replies to the questions which I have thus ventured to propose,

I am, Sir, yours, &c. O. C. F.

CONDUCT OF THE NEW POLICE IN CASES OF FIRE.

Sir,—Notwithstanding the numerous intimations of the impropriety of breaking open doors, &c. to the lower parts of houses discovered to be on fire, our new watchmen appear not to have had any instructions on that subject; for in several recent instances we are informed, the first steps of the police-men was to "break open the doors."

Allow me here to mention a circumstance which appears to have escaped the notice of the gentleman who has spoken so much in praise of the cast iron breastsummers, recently introduced in the Strand. In the event of fire, although these girders will not burn, yet they will become heated, and the water being thrown upon them in that state will cause them to crack; in which case there is no more security for the brickwork, than if it had been supported by a wooden beam.

I am, Sir, yours, &c. J. S. S.

INTERIM NOTICES.

We feel oblized to W. H. B. for the trouble he has taken; but there are too many matters of living interest claiming our attention, to leave us at liberty to spare room for the tombs either of Greek Emperors or Irish Kings.

"One who has recently become a Subscriber" will obtain what he inquires about in Gilt-spur-street.

The impression of the lithographic Engraving of the Steam Carriages given in our last number having been exhausted, another edition has been published, executed also on stone, but in the chalk manner, and on large paper. It will suit well for framing or portfolios. Price 1*s*.

Communications received from D. Y. R.—A. W.—Mr. Murdoch—Mr. Cookes—Mr. Otty—Will—Mr. Hayter—Mr. Hopwood (3)—Mr. Russel—I. R.—James C—A Constant Reader—S. P. W.—Novice—J. O. B.—C. B——l—In—y—Mr. Russel—Juvenis—Y.—Investigator—A Sincere Friend—Mr. Taylor—Mr. Baddeley—Mr. Jopling.

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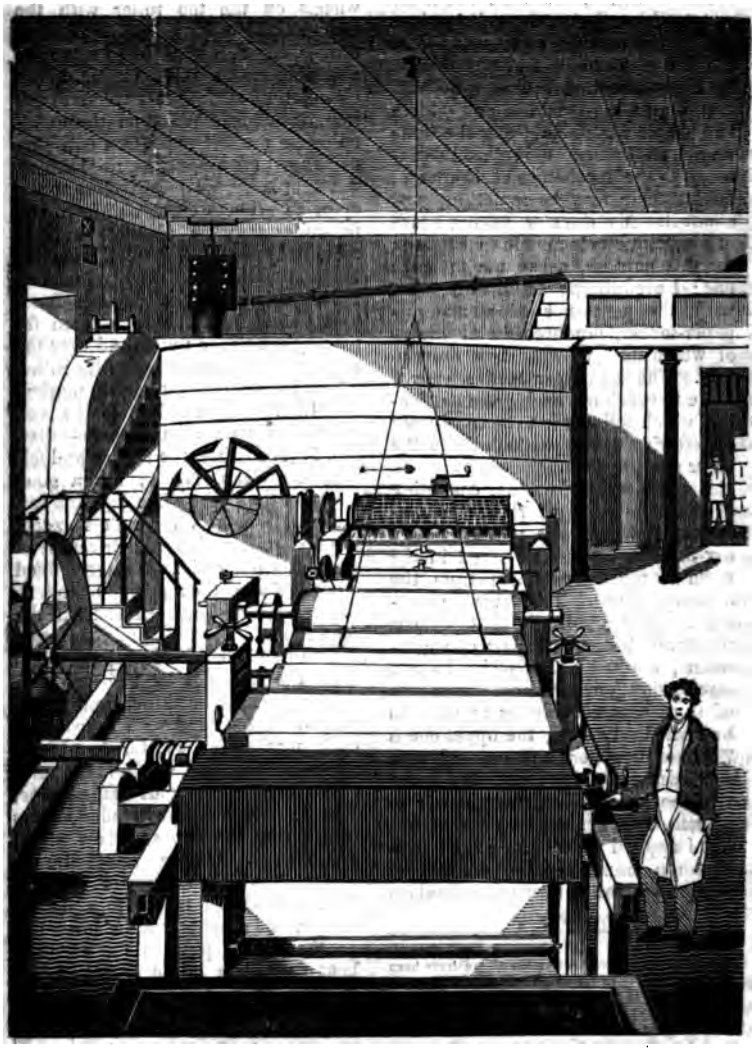
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 331.] SATURDAY, DECEMBER 12, 1829. [Price 3d.

RUSSIAN IMPERIAL PAPER MANUFACTORY.



DESCRIPTION OF A PAPER-DRYING APPARATUS EMPLOYED AT THE IMPERIAL PAPER-MILL OF PETERHOFF, IN RUSSIA, INVENTED BY MR. WILLIAM REED.

Dear Sir,—I send you an account of a paper-drying apparatus, with a plan to scale, which has been in work here night and day for upwards of four years, and with the help of a boiler of little more than two-horse power, dries the paper well, and as fast as two machines can make it at the rate of 25 to 30 feet per minute. As I never saw or read of a description of a drying-machine, and seldom two people contrive a thing the same way, I am induced to present this account to the mechanics of England; hoping there may be something new about it. My director having heard of a machine being made in England for this purpose, asked me to make one: I accordingly set to work, and, with the assistance of a machine paper-maker, produced the apparatus of which the following is a description. The large perspective view I leave to speak for itself; the particulars which follow are to be considered as referring more particularly to the other drawings.*

B exhibits the elevation, consisting of 8 steam-rollers of 13 inches diameter; No. 1 is the paper-machine dry-press cylinders (so called in the trade to distinguish them from the other cylinders). The paper on leaving the machine in the wet state is put through the first pair of steam-rollers, marked No. 2, which have a lever-weight on each end. This pair of stout copper cylinders requires to be turned very true; the upper one is 7 inches diameter, and covered with a felt drawn on very tight. We found that the lower roller, though ever so smooth, soon acquired a crust of fur, but I applied a steel blade fixed in a cast-iron frame for the purpose of scraping it, called by machine-makers the *Doctor*. It requires, however, a little cleaning once a fortnight with pumice-stone and water, which is soon done without removing the roller out of its place. The under roller having not only its own weight, but that of the upper roller loaded with lever-weights, I found that turning on friction-wheels was far before any other mode of bearing. I had a small frame with two small friction-wheels on the top roller with the lever-weights attached. The friction-frames, No. 2, are of iron, and set on a double-bridge piece C. No. 3, (an elevation of steam-press rollers) is of iron, as before. When on the wooden frame the wet and steam caused a twisting, and there was no keeping the steel knife, or doctor, close to the cylinder. The weight on the upper felt-roller may be about 3 cwt. or more; the use of it is to take out the machine felt-mark. The remaining rollers are just wide enough for a man's hand to get between them for passing the paper under and over the rollers till it arrives at the fifth roller, where the endless felt begins, marked No. 4. It is then led on to the reel, which, as well as the drum-roller, No. 5, for driving the rollers and felt with the strap, No. 6, has a good stress on the paper when dry, and can turn the whole of the rollers except the first pair, which are driven by a strap at each end and riggers fixed on each end of the machine-cylinders, marked No. 1, (but seen better in the plan A.)

The method of admitting steam from the boiler is by two-inch iron pipes under the machine, from which rises a leaden pipe with a two-inch cock, marked No. 11, for stopping or starting. On one side of the machine there runs a stout leaden pipe, No. 7, wherein the stuffing-boxes (containing the copper elbow pipes) are soldered. On the end of the cylinder at which the steam enters I have a steel end turned to a hollow sphere, and a corresponding brass end on the copper pipe to fit, which is kept up with a bridle and wedge at starting, as when cold the valve is nearly one-eighth of an inch apart (as represented at D, No. 8.) The cast-iron bearings for the light or thin

* The "large perspective view" we have been obliged, owing to the smallness of our page, to divide into two parts, one of which only we give this week. The other half, with the rest of the sketches referred to, shall be given along with the conclusion of this article next week.—*Edit.*

rollers are merely screwed to
chine-frame, marked No. 9,
a pin for tipping up the end
larionet-valve, (so called from
rmed like the best metal keys
sort, a likeness, however, which
not find out till after I had
t work,) but having the valve
n the edge of the cylinder.
is get rid of all the condensed
having a trough to take it back
eed-head of the boiler, under
chine-room.

(To be concluded in our next.)

ANNIVERSARY OF THE LONDON HANICS' INSTITUTION, 4TH DE-BER, 1829.

idged from the Morning Chronicle.)

few minutes after eight o'clock,
kbeck, the President of the Insti-
took the chair. He was accom-
by Mr. Brougham, M.P., Mr.
M.P., Mr. S. Rice, M.P., Dr.
, the author of the Elements of
and several other eminent cha-
.

BIRKBECK opened the business of
ning by an animated address.
gan by justly remarking that the
of the diffusion of knowledge
hail the prosperous existence of
itution, which had passed through
rs of perils and evil prophesyings,
elings of exultation and delight.
stitution had inflexibly adhered
hout its triumphant career to the
ducational purposes for which it
t its commencement, unreservedly
ced to be founded. Dr. Birk-
ben congratulated the meeting on
vourable opinion now generally
ined of such institutions, and
d to the only two examples be
tely met with of any observations
been made against them, namely,
rving and Sir Humphry Davy.
tter, in his work entitled "Sal-
," had thrown out some doubts on
ility of imparting scientific in-
on to the working-classes, which
irkbeck showed were uncalled for
nfounded. During the last year
not know of more than two Me-
s' Institutions which had been
ished—one was at Oxford, and
her at Newport Pagnell. Of that
ord, Sir Joseph Locke was Presi-
and Dr. Daubeny, one of the Pro-
s of the University, Vice Presi-
-and it had already attained a very
success. *In conclusion*, Dr. Birk-beck announced that they would pro-ceed to the business of the meeting, which was to award two prizes, liberally given by Dr. Fellowes, for the best Essay and the best Machine, whether original or improved. He would first of all call on Mr. Toplis, one of the Adjudicators, to read the Report they had made.

Mr. TOPLIS then read the following Report:—

"*Report to the Committee of the London Mechanics' Institution on the Adjudication of Dr. Fellowes's Prizes for the Year* 1829.

"We, the undersigned, being appointed adjudicators of the prizes given by Dr. Fellowes to members of the London Mechanics' Institution, having duly examined and compared the several models of machines and essays sent in for competition this year, do concur to award the prizes to the inventor of the model marked ☊; and to the writer of the essay bearing for motto 'At spes non fracta.'

"On no former similar occasion has the task of the adjudicators been so highly gratifying as on the present one, which has brought to them the elating conviction that the enlightened views of the generous founder will not, cannot now be disappointed. Talent is elicited from amongst the members of the London Mechanics' Institution, which school has furnished to them the means—and adequate means—for its culture and development.

"The machine for which the prize on this occasion is awarded, is professedly for the object of cutting buhl-work, with more facility and accuracy than by the means heretofore in use. It admirably effects its object, and it will do much more; for its use will not be limited to the circumscribed object which its inventor has designated. By this invention, that invaluable engine the lathe adds to its multifarious uses, by simple and not expensive contrivances, the rectilineal reciprocating action of the straight-edged saw. The advantages and extensive applicability of such a movement, directed with a precision which the hand could never ensure, the workman will at once appreciate. The inventor has accomplished his object—a novel application in mechanical power to an established branch of manufacture, by means simple, ingenious, cheap, and efficacious.

"On the subject of the competing essays, the adjudicators have to applaud the change which has this year been made, of limiting all the competitors to one subject. Their respective merits are more fairly brought into comparison. —The matter proposed to be treated in the present competition is of more difficult investigation, than were the subjects which the writers had the choice of on former occasions; but it has, notwithstanding, found amongst us minds ready to cope with, and sufficiently vigorous to master all its difficulties. The present prize essay is a performance of which the Institution may be proud. The writer of it has shown the hand of a master. He has treated his subject amply, and investigated it profoundly. His conceptions are lucid, his method logical, and his enunciations perspicuous, concise, and elegant. The essay comprises all that is essential of theoretical investigation and practical illustration on an instrument of great philosophical importance and diffused social utility.

"Amongst the competitors we could but select two; and this is the only circumstance which could tinge our labours with regret; for assuredly those who are not chosen are several who, though unsuccessful, are far from undeserving. The prize essay is run very close; and the compari-

tion amongst the mechanists affords a gratifying display of ingenuity and talent, and knowledge, directed with judgment to objects of usefulness.

" GEORGE BIRKBECK, President.
" JOHN MARTINEAU, V. P.
" CHARLES TOPLIS, V. P.

" London Mechanics' Institution,
" Nov. 30, 1829."

The two persons to whom the prizes were awarded were Mr. Henry Poole, a stone-mason, for an excellent essay on the pendulum; and Mr. M'Duff, a working-turner, for an improvement on the lathe, by which it can be applied to cutting out buhl, or inlaying work. Of Mr. H. Poole, Dr. Birkbeck remarked that he was an operative, and nothing in rank but an operative, who, two years ago, had recorded in a book kept at the institution, a very interesting account of his progress in knowledge, generously attributing that, much of which was due to his own talents, perseverance, and industry, to the instruction he had received at the institution. When he became a member of it at its commencement, he had hardly a definite idea of what was meant by geometry, and knew nothing of the philosophical meaning of mechanics. Yet the essay produced by this gentleman was pronounced by Mr. Dotchin, an eminent mathematician, to be the work of an accomplished scientific man. Mr. Poole had never, in prosecuting his studies, lost one hour's work, or thrown away one penny-worth of time he could employ in labour. He had only devoted to his studies that leisure time he was not engaged in providing for his subsistence. Dr. Birkbeck then presented Mr. Poole the prize, and said, he was both proud and delighted to offer him the reward; proud to find in him such beneficial consequences of the London Mechanics' Institution, and delighted to find himself in a situation to bestow on him a public testimony of approbation. He understood that Mr. Poole meant to become a teacher of mathematics, and he hoped he would succeed. Mr. Poole, of course, came forward to receive the prize, and was received with great approbation by all present. In the course of his observations, Dr. Birkbeck mentioned that Mr. Poole had on a former occasion written an Essay which was unsuccessful, and to which he had affixed the motto of "*Spes.*" To the present Essay he had affixed the motto "*At spes non fracta,*" which had been, by his success, fully justified.

Mr. M'Duff, who had been a turner at Dunkeld, afterwards a cabinet-maker at Perth, and is at present employed in some large establishment in London, was then called forward to receive the prize for the best machine. The machine itself was produced, and Mr. M'Duff cut out very rapidly some beautiful specimens of pieces for inlaying. It consists of the application of a very fine saw, fixed perpendicularly to a common lathe, and made to move with a very rapid up and down motion, by the action of the foot. The object to be cut out by the saw preserves the true horizontal position like things placed in a lathe, so that the work cannot be otherwise than true. The machine is susceptible of a great variety of applications; cutting dissected maps in pieces, for example, and Mr. M'Duff cut out of a map of the globe, with extreme precision, the whole American continent. In making inlaying work, two pieces of different coloured woods are placed together, and the instrument is so perfect that both are cut out at the same time, and one then fits the other. By this very beautiful machine buhl-work may now be done in a few hours, which, without it, required weeks of close and careful labour; and the machine is so simple that any person capable of turning can successfully use it. In bestowing the prize on Mr. M'Duff, Dr. Birkbeck said he hoped he would go on perfecting himself in knowledge, and in applying that knowledge to other equally useful things. He had already benefited his country by the invention of a skilful contrivance of great importance; and in the career Mr. M'Duff was pursuing, he (Dr. Birkbeck) was quite sure that he should never have occasion to use the language of the dramatist to him, and say, " Hold, enough."

Mr. BROUGHAM then rose to address the meeting, and was loudly welcomed. It was unnecessary, he said, to preface what he should propose to them with any remarks; they had so long enjoyed the inestimable benefits conferred on them by the *Founder* of the Institution, through the six years in which his labours had so largely contributed to promote the prosperity of the London Mechanics' Institution, that it was not necessary for him to call on them to testify to Dr. Birkbeck their respectful and affectionate attachment; it was due to him not only from the members of all the Mechanics' Institutions, which had grown up rapidly into importance in this country, but even from the members of those which were rising up beyond seas. Something had been said about the few institutions which had of late been founded, but this probably arose from a want of knowledge of what

had been done; and he regretted that a correspondence had not been carried on between the parent institution and the other institutions in the country. Perhaps, however, this was hardly to be expected, as the officers of the Institution had various duties to perform, with which such a correspondence might interfere; but he hoped that in another year means would be found for carrying on such a correspondence by another institution, which would enable them next year to give an accurate and detailed account of the progress and state of such institutions throughout the country, and to announce that several new ones had been founded. Though unwilling to trespass on their time, he could not avoid expressing the extraordinary gratification he felt at witnessing the talents, the industry, and virtue, which had been brought under their notice that night by the successful candidates for the prizes. If any body thought that scientific education did not give strength to virtue, and energy to talent, what had passed before them must put to flight all such notions. Such an education did not distract the attention of mechanics from their proper avocations. There was Mr. Poole; he had neglected no duty; he had absented himself from no employment that was necessary to secure his personal independence, the first object at which every man ought to aim; and while he had continued at his labour, he had so accomplished himself in the abstruse and difficult and sublime science of mathematics, as to produce a work which would do honour to a Professor of Mathematics. The persons present must be sensible that no departure had been made from the principles on which the Institution was originally founded; and what had then taken place was a satisfactory test of the soundness of those principles on which all such institutions had been established. He had cast a glance over the Essay, and he perceived that Mr. Poole had used the integral calculus: indeed, it was not possible to enter into the investigation of the very difficult problems of the pendulum with the fluctional calculus; and the individual who had made himself so accomplished, had not taken one hour from his occupation. Mr. Poole had taken hours from sleep; and he (Mr. Brougham) would venture to say, not frequented places of idle amusement and of drunkenness. He was a highly-gifted and a highly meritorious individual. With respect to the mechanical contrivance which had been submitted to them, he must say that it possessed all the qualities of a great invention. It was so simple that any body might use it, and so plain that it was easily understood. Every man in seeing it would instantly comprehend it, and wonder that it had never been discovered before; but he could say that it had not. This was the characteristic of all great and useful inventions. He had seen a great many instruments and machines, and hardly ever saw one that was at once more efficacious and more simple. He did not wish to trespass longer on their attention, but he could not avoid giving vent to the great admiration he felt at seeing the fundamental principles of the Institution so steadily kept in view, and at beholding such beneficial results from them. He had nothing further to add, but that they should all tender a testimony of their affection and respect to their worthy and excellent Chairman. (Great applause.)

Mr. Brougham put this motion, which was carried by acclamation.

Dr. Birkbeck briefly returned thanks.

Mr. Spring Rice said he was not willing to trespass on their attention; but he could not, taking, as he did, a sincere interest in the welfare of the Institution, and being, perhaps, the only Irishman present who could bear testimony of the use of its example in Ireland, avoid answering the call which had been made on him to give them some information on the subject of Mechanics' Institutions in Ireland. It was in the North of Ireland, particularly, that the influence of their example had been most beneficial. An institution had been established at Belfast, at Dublin, at Cork, and at the city with which he was more immediately connected (Limerick), and they were all sensible of the great advantages derived from the Parent Institution. It would be in bad taste were he to trespass longer on their attention, and he would therefore only propose the resolution which had been put into his hands. The Hon. Gentleman concluded by moving this resolution:—

"That this Meeting has heard, with the highest satisfaction, that the silent and ordinary operations of the London Mechanics' Institution have fully realized the expectations of its Founders, in the beneficial influence it has produced on individuals, as well as its obvious tendency to improve society at large."

The resolution was carried by acclamation.

Mr. Hume, in moving the next resolution, observed, that every

be sensible of the value of that information which such institutions were calculated to afford, and he should have been very glad to have had an opportunity of acquiring such information. There was no sort of institution which better deserved the support of Government, even according to its own views, for Mechanics' Institutions would increase the revenue. The country depended on trade and manufactures, and such inventions as they had beheld would increase the trade and improve the manufactures of the country. One hundred years ago buhl was a most costly work, but it might now be obtained, as they saw, at a small expense. He did not ask the Government to encourage such institutions, but he regretted that it had not, when it was in the habit of encouraging other institutions, extended more countenance and protection to Mechanics' Institutions, which were admirably calculated to increase the ingenuity and resources of the country. Mr. Hume concluded by moving the following resolution, which was unanimously carried:—

"That as a living engine by which the best interests and the purest feelings of man may be eminently promoted, this Institution deserves the greatest encouragement from all who have themselves felt the benefits of education, and who desire either their own welfare, or the intellectual or moral improvement of others."

Mr. TOOKE then moved—

"That the cordial thanks of this Meeting be given to Dr. Fellowes, for his great liberality in instituting the prizes presented this evening, as well as on former occasions, the effect of which has been to afford the most indisputable proofs of the intellectual resources possessed by the members of the Institution."

Which was also carried by acclamation.

Dr. BIRKBECK, in acknowledging, for Dr. Fellowes, this mark of approbation, informed the Meeting that Dr. Fellowes had stated that he was the proprietor of several presentations to the London University, and that he should always have some to offer to such members of the Institution as, having gained prizes at it, had an intention of following up their studies at the University. Such an offer would be an encouragement for them to follow up their studies, and it was a valuable addition to those prizes Dr. Fellowes already bestowed.

Thanks were then voted to Dr. Birkbeck for his conduct in the chair.

Dr. BIRKBECK, in returning thanks, said it was only necessary that Mechanics' Institutes should be sufficiently known to insure them that support to which they were entitled. It was only necessary that their effects on the conduct and welfare of individuals should be seen, to put an end to the fears and apprehensions which were yet felt by a few persons, and place them on a proper footing in the minds of the community. In them there was no danger; on the contrary, they were a national benefit, and were calculated not only to extend the happiness and increase the welfare of individuals, but to augment that skill and that knowledge which were the true supports of the national power. (Great applause.)

We are sorry to be once more obliged to expose the gross delusion which it seems to be now the stated business of the Anniversaries of this Institution to practise on the public.

The grand object of the proceedings which we have just reported is to hold forth to the world that the "London Mechanics' Institution" is in *an excessively prosperous condition*. The President, Dr. Birkbeck, affected to be almost overcome by "the feelings of exultation and delight" with which he reflected on the "triumphant career" and "prosperous existence" of the Institution. And the resolution which was *put into the hands* of Mr. Spring Rice to move, solemnly declares that "the silent (silent with a witness!) and ordinary operations of the "London Mechanics' Institution" HAVE FULLY REALIZED the expectations of its founders."

We have many reasons for wishing this were *all true*, but we grieve to say it is positively *all fudge*. The Institution is *not* in any light in which it can be viewed, either "triumphant" or "prosperous," and considered as a *Mechanics'* Institution—in which character alone it solicits distinction—it is now, and has been for some time, on *the very verge of ruin*. We were foremost amongst its "founders"—its "*earliest effectual projectors*," to use Dr. Birkbeck's own words—(see his Inaugural Address, published at length from the original manuscript in the "Mechanics' Magazine," vol. i. p. 418.)—and for ourselves we must solemnly declare, that so far from its having "*fully realized*" *our* expectations, it has falsified them most lamentably.

We need not state *all* the facts which have brought us to this most painful conclusion; half-a-dozen of the more prominent may suffice, and as the official evidence bearing on them is not in our own hands, but in those of the Managers of the Institution, we shall put them in the way of questions to these gentlemen, in order that they may set us right, if that evidence has been in any particular misrepresented to us.

1st, then, Is not the number of members of all sorts less by *several hundreds* than it was during the first and second years of the Institution?

2. Did not the great majority of members consist at first of working mechanics? And does not the great majority consist now of persons who have no pretensions to that character?

3. Are there more than 200 working mechanics now belonging to the Institution, out of the hundreds of thousands resident in this metropolis?

3. Has not the regular contributions of the members ceased to be adequate to defray the expenses of the Institution? And have not the Managers been induced, in order to make up the deficiency, to have recourse to Benefit Concerts, Benefit Steam-Boat Excursions, Benefit Sporting Exhibitions, and other Benefit shifts of a like beggarly and disreputable description?

4. Was not the Institution commenced on the principle of *self-support*; and has it not begged and borrowed more, and been more indebted to gifts and gratuitous services, than any other scientific institution in the three kingdoms?

And, 5. Is not the Institution at this moment, notwithstanding all the helps it has received, and all the brag and swagger of all its annual meetings, over head and ears in debt?

We believe that not one of these questions can be truly answered in the negative; and if such be the case, we put it to Messrs. Brougham, Hume, Rice, Tooke, and Arnot, as men of honour and friends to the objects which Mechanics' Institutions are meant to serve—whether they have not been inveigled into a participation in an act of gross delusion, in holding forth an Institution which has thus fallen into decay—which has been thus repudiated by the mechanics of the metropolis—as being, on the contrary, in the highest degree "triumphant" and "prosperous?"

The "exultation" of Dr. Birkbeck is to be *easily accounted* for, and as *easily excused*. It is the make believe shift of a man in a state of desperation. His reputation, in as far as it is connected with the cause of popular instruction and a sum of between £3000 and £4000, which he has lent to the Institution, are both at stake. But the participancy in the humbug, of such men as Mr. Brougham, Mr. Hume, and Mr. Rice, who can have no other than public motives to actuate them, is only to be accounted for on the supposition that the real circumstances of the Institution have been carefully concealed from them.

The interests of the Institution, and of all those interests liable to be affected by its example, will best be served by letting *the whole truth* in regard to it be known, and ascertaining to what causes it is owing that it has proved so complete a failure. Most of these causes we have from time to time pointed out; but until it shall be seen whether the gentleman, who holds this Institution in his creditorial grasp, is disposed to enter upon the work of its reform in a pure and honest spirit—to forego all quacking and charlatanry—it would be a waste of time to recur to them in detail.

Mr. Brougham dropped a hint in his speech about "*another Institution.*" Is Mr. Brougham then beginning to anticipate the probable necessity of such a step? If the Institution will not prosper under the direction of Dr. Birkbeck, and the Doctor and his debt cannot be got rid of, "another Institution" does appear to us to be the only remedy.

Of Dr. Birkbeck's devotion to the cause of Mechanics' Institutions there can be no doubt; but it seems to be an ingredient of that devotion that he shall be acknowledged to be their great founder and master-spirit. There is a characteristic letter of the Doctor's extant, in which he asserts that "two of the most malignant men living are Dr. Ure, of Glasgow, and Mr. Robertson, of the Mechanics' Magazine." For what reason does the reader think? Dr. Ure is "malignant" because he will not allow the founder of the "Andersonian Institution" of Glasgow (of which Dr. Ure is now, as Dr. Birkbeck once was, Professor) to be robbed by Dr. Birkbeck of the honour of having founded the first school in Great Britain for the use of mechanics. And Mr. Robertson is "malignant" because he happens to be the individual who projected the "London Mechanics' Institution," and gave that impulse which has led to the formation of so many similar Institutions throughout Eng-

land; because he has been uncivil enough to let all the world know, that when he was moved to these things, he knew nothing of, and had nothing to do with Dr. Birkbeck, who with all his zeal for popular instruction, had dozed away eighteen years in the metropolis without ever once thinking of founding therein an Institution similar to that of which he had witnessed the practical benefits in Glasgow; and because he persists in maintaining that it would have been better far if Dr. Birkbeck had continued to doze on, in pill-prescribing obscurity, and never meddled more with Mechanics' Institutions; since he has only awakened from his slumber, to insinuate himself into a leadership, of which he is incapable, and by which he has done a vast deal more harm than good to the cause of popular instruction.

Dr. Birkbeck wants every thing that is essential to the character of a successful leader. He wants energy; he wants decision; he wants determination; we suspect he also wants assiduity. He can speak well, and that is nearly all he can do. The "Mechanics' Institution" is not the only Institution in the metropolis which has suffered by his friendship; almost every other with which he has been connected has had the same tale of ruin to tell.

It is scarcely necessary to observe, that it forms no material deduction to what we have said of the Institution itself, that it should occasionally be the means of eliciting such gratifying displays of humble genius as were honoured with prizes on the present occasion. These are but insulated proofs of the good which can be effected by such an Institution *in spite* of all the bad management to which it has been subjected; only examples of the unbounded usefulness of which under abler direction it is susceptible.

One word more; it relates to but one word in Mr. Brougham's speech, which we have marked in italics. We are persuaded that that word never was used by Mr. Brougham, in the singular number at least; and this for the best of all reasons, namely, that Mr. Brougham now knows the truth of the case too well to have used it. We all know how liable the reports of oral addresses are to inaccuracies; but when the reader is informed that the reporter on this occasion for the *Chronicle* was Dr. Birkbeck's man, Hodgkin, who has lain for two years and a half under an uncontradicted charge of wilful misrepresentation in relation to the very same matter of fact, (see "Mechanics' Magazine," vol. vii. p. 382.) he will readily understand how there may have been a motive for making Mr. Brougham appear to say what we are convinced he never did say. The Doctor's man should rest content with bepraising his master through the medium of lying dedications of his own, and not make use of honourable names to give a seeming countenance to his contemptible servility.

ON CHURCH BELLS; THEIR SUBSTANCE, WEIGHT, AND FORM; MODE OF FIXING AND STRIKING, &c. &c.

"Bells are for all things, all events:
For victories, for fires,
For hanging crimes with ill intents,
Or law-proscribed desires.
For this, St. Bride her turret rocks,
For that St. Dunstan rings;
The last St. Sepulchre so shocks,
That all about him *swings*."

GEM, for 1830.

Fourteen centuries have now elapsed since the invention of bells, but it is not, comparatively, till of late years, that the attention of scientific men has been directed to the investigation of their proper form and composition.

The object which the ancients evidently had in view, was to collect the greatest possible mass of metal into their bells—the heaviest being most esteemed. The extent to which their labours were carried may be illustrated by the following list of a few of the largest bells, commencing with

	lbs.
That at Moscow, cast by order of Anne, Empress of Russia, which weighed	432,000
Seven bells at Pekin, China, each of which, according to Father le Compte, weighed	120,000
St. Peter's (re-cast in 1785)	18,667
The Mighty Tom of Oxford	17,000
The Great Tom of Exeter	12,500
The do. do. of Lincoln	9874
The Tom Growler (St. Paul's) London	9320

s which, there are several others
sense weight, both in this and
countries.

miraculous powers ascribed to
in the dark ages of monkish
dition, have been long since ex-

Perhaps the most ridiculous
the extravagant practices of
times was "the Passion-bell,"
ed from being appropriated to
rvice of Passion-week. "To
his bell a tone appropriate to
mbre character of the season, it
en cast with several large holes
the top—a contrivance which,
t diminishing the vibration of
tal, prevents the distinct forma-
any musical note, and con-
he sound into a dismal clan-

During the continuance of
es like this, little improvement
be expected in the construction
a.

-founders of the present day
owever, begun to perceive the
se waste of metal hitherto in-
and are convinced that a bet-
nd may be obtained with, at
one-half the weight of metal
y used.

appears to be the opinion of
lented correspondent, Mr. Har-
who in his interesting commu-
n, at p. 377, of your last vo-
ays, "My researches have not
een directed to those propor-
hich will afford the greatest
st flowing sounds and deepest
ith a minimum weight of me-
it they have also been directed
t a perfect concurrence of all
rts, so that the sweetest tones
: the same time be produced.
er, these proportions have also
ct of improving the shape con-
ly, it being allowed to have a
mmetrical and handsome ap-
ce, so that it perhaps may not
erly be styled the perfection of
l form." This is a somewhat
l idea of Mr. Harrison's, and
apply to some improved bells
ave seen, which possessed the
h and mellow tones, but cer-
ne of "*the perfection of the*
," as regards appearance.
the greatest respect for the

abilities of Mr. Harrison, and our other enlightened bell-founders of the present day, permit me to observe, that notwithstanding the great antiquity of bell-founding, I am of opinion that the art, in regard to improvement, is yet in its very infancy; and that no investigations yet made have furnished data sufficient to *establish* the form best calculated to give a maximum effect with a minimum weight of metal, in the construction of large bells.

Let any one, for a moment, consider the vast difference in form which exists between musical clock-bells and those of a larger description. A comparison, of effect, in proportion to the weight of metal, is very much in favour of the former, but I have some notion that *perfection* lies in a form somewhere between the two. M. Reaumur, in a paper in the "Memoirs of the Paris Academy," on the shape most proper for bells to give them the loudest and clearest sound, observes, that "lead, a metal which in its common state is not at all sonorous, becomes greatly so on its being cast into a particular form, and that very different from the common shape of bells." This form, M. Reaumur afterwards observes, is the segment of a sphere, which shape is now given to the best musical-bells, varying, however, in being more or less oblate; and he continues, "now, if this shape alone can give sound to a metal which in other forms is perfectly mute, how much more must it necessarily give it to other metals naturally sonorous in whatever form." M. Reaumur very judiciously observes, that had our forefathers possessed opportunities of being acquainted with the sound of metals in this shape, we should probably have had all our bells at present of this form. Mr. Drury, whose inimitable musical-bells are so well known,* has of late extended his researches to bells of a larger description, some of which he has cast and fixed; and he goes so far as to say, that he will produce a bell of any required note with ONE-FOURTH of the metal formerly used, and at the same time obtain a far more harmonious tone.

's "*Every-Day Book*," vol. ii. p. 392.

* See vol. vii. p. 138.

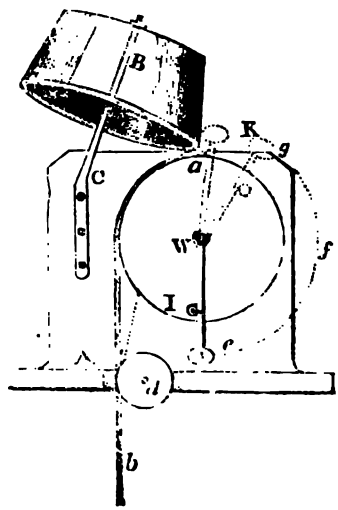
Another practice, which to me appears highly absurd, is the present mode of bell-*ringing* — where the whole mass of metal in the bell is put into motion to obtain that sound, which may be better elicited by moving the clapper only. For I am thoroughly convinced that a much finer tone may be drawn from every bell by a well-struck hammer, than by any swing that can be given to a clapper in the interior of the bell.

We frequently read of bells that require *twenty-four* and *thirty-two* men each to ring them—whereas, one man with a suitable hammer might have produced an equal, or even a superior sound. The bell at St. Paul's Cathedral is by some said to weigh 11,474 lbs., and its clapper 180 lbs. To make this large mass revolve, as it were, round the smaller, is as though the earth were to revolve round the moon, or the sun round the planets—while the reverse is well known to occur in the harmonious arrangements of Nature. In addition to the immense waste of human labour, which takes place in our present mode of bell-ringing, there is another objection to this practice, from the liability to accident, and from the injury done to steeples, the stability of which, sooner or later, becomes destroyed.* Where the soundness of any steeple is questionable, it is necessary to put an immediate stop to the practice; and though not generally known, it is nevertheless a fact, that nearly one-half of the peals of bells in this country cannot at the present time be rung with safety. This is at present the case at Bow Church, the weight of whose bells is as follows:—

	cwt.	qrs.	lbs.
First	8	3	7
Second	9	2	0
Third	10	1	4
Fourth	12	0	7
Fifth	12	0	24
Sixth	17	0	11
Seventh	20	2	26
Eighth	24	2	25
Ninth	34	2	6
Tenth	53	0	9

In all about 10 tons, which swinging to and fro in such a place as the upper part of a high steeple, is sufficient to shake even those of the firmest construction. I should estimate the clappers of all the above to weigh about 400 lbs., which is all that need be put in motion to obtain the full effect from the bells.

When it becomes unsafe to ring the bells, they are what is technically called "clappered:" in this case the clapper only is put in motion, but under such unfavourable circumstances, that no wonder the sound thus produced is inferior to that obtained by ringing.



The above sketch exhibits an improved mode of fixing and striking bells, invented by Mr. Drury:—Upon a stand or upright piece of strong timber, A, the bell, B, is supported by an iron arm, C, incapable of motion: upon an axle, securely fastened to the stand A, revolves a small grooved wheel, W: upon the same axle, also, freely revolves a rod or lever carrying the

* On Monday afternoon, Nov. 9th last, while the grand peal of ten bells in the tower of St. Sepulchre's Church, Snow-hill, were ringing a merry peal (Whittington's) as the Lord Mayor's procession was passing, the tenor, or great bell, weighing 3300 lbs., broke asunder at the crown, and fell with a most tremendous crash into the pit beneath, to the great alarm of the ringers, who were three floors under, and were shook as if by an earthquake. They were, however, saved from the destruction, by the strong oaken *timbers of the floor*, which received the bell, *and arrested* its further progress.

hammer, H. At one point of wheel *a* is attached the rope *a*, *b*: on the face of the wheel there is a projecting stud, I, against which the clapper-arm rests. When the bell is required to be rung the rope *b* is pulled, which brings the point *a* of the wheel into the lowest position, and at the same time raises the hammer into the position K by means of the stud I, upon which it rests; describing the arc *e*, *f*, *g*. In passing over this distance, however, the hammer will have acquired such a momentum, that it will not stop with the wheel, but, leaving it, will strike the bell with such force, as to draw forth its full tone with the finest effect. The blow having been struck, the hammer falls back, partly from reaction and partly from its own gravity, upon the stud I, and carries the wheel round into its original position, when another blow may be struck, and so on, *ad infinitum*. The parallelism of the rope is maintained by a small grooved wheel, *d*.

With this mode of fixing and striking, the full tone of the bell is obtained with the greatest ease, and with unexampled rapidity. M. Perrault considers bells as composed of an infinite number of rings, which, according to their different dimensions, have different tones, as chords of different lengths have; and, when struck, the vibrations of the parts immediately struck determine the tone; being supported by a sufficient number of consonant tones in the other parts. I should therefore suppose the fewer the number of these rings —and the smaller their difference in length, and consequently in tone— the more uniform and harmonious will be the sound produced. The form of bell adopted by Mr. Drury, as sketched above, coincides in every respect with this position: the high notes produced by the smaller rings of bells of the usual form, which are antagonizing ones, are in the new form wholly got rid of; and this may, in some measure, account for the depth of tone which these bells possess.

Before dismissing this subject, I may observe, that the just proportions of *weight* and *velocity* for the hammers of clock bells, furnishes an interesting and ample field for speculative research. The existence of these proportions is by some denied: that they do exist, however, may be satisfactorily established, by considering the two extremes of the case. Thus, for instance, let us take the great bell at St. Paul's Cathedral; and, in the first instance, suppose that an iron musket-ball, weighing one ounce, is fired direct against it: in this case we have a hammer of *small weight* moving with prodigious *velocity*. Secondly, let us suppose a weight of nine or ten tons moving very slowly, say through the space of two or three inches per second, or at such a rate that its numerical momentum shall be the same as that of the musket-ball in the first instance: in this case we have *great weight* with a very small velocity; and it is pretty clear, that in neither case will any thing like the full tone of the bell be brought out: it remains therefore to ascertain that proportion, in which the weight and velocity of the hammer shall be such, as to produce the full effect of the bell. Inattention to this circumstance, is in many cases the reason why such an imperfect sound is elicited from bells when struck by the clock-hammer, and is an error into which the best workmen have sometimes fallen.

Europeans generally use iron, the Chinese wood, for the construction of bell-hammers. The iron is unquestionably the best of the two; but I am of opinion, that some substance, perhaps an alloy, may yet be discovered far more appropriate than either one or the other. Without farther trespassing upon your pages, permit me to say, I remain,

Very respectfully, yours,
WM. BADDELEY, JUN.

THE COMPANION TO THE ALMANACS FOR 1830.

We have not as yet had time to do more than glance over this supplement or helpmate to "The British Almanac" for 1830. It contains a good many articles of general information, but intermingled, we are sorry to say, with not a little trash. There is an article on Saints' days, which has evidently for its object to defend the "Useful Knowledge Society" from blame for the freedoms they have used

in regard to these ancient time-marks; but the defence is incomplete, for in the list of Saints' days omitted, because their "commemoration" "does not in the least degree influence the proceedings of the present time," there are several which do influence "the proceedings of the present time" most decidedly, inasmuch as they regulate the holding of *Fairs*, where people assemble in hundreds and thousands to traffic in rural commodities. Is it to be characteristic of "The British Almanac" to supply information which is useful only to lawyers and landlords, and withhold equally useful information from the honest yeomanry of the country? There is also the promised article on the tides by J. W. L(ubbock) Esq., F. R. and L. S. which more than confirms all that we advanced in our review of the almanac in regard to the author's fitness for the task he has undertaken. It is as elaborate a piece of mathematical priggism as ever came under our critical notice; composed of English not always intelligible, Latin scraps quoted for mere parade, and the signs and symbols instead of any of the body and substance of scientific talent. We hope to be able in the course of a week or two to unravel this web of absurdity. Meanwhile we may observe, that from an authoritative paper to which a Member of the Committee of Superintendence subscribes his name, we learn, 1st. That the tide-table of "The British Almanac" for 1830, does not relate to London *Bridge*, as has been usual, but to the London *Docks*. 2nd. That the Society are in great dudgeon (p. 26) because the computers of tide-tables withhold the secret of their art from their generous rivals—rivals who first pirated the calculations of these computers, and then pretended that there was nothing in them worth pirating! 3rd. (p. 36) That the times of high-water given in "The British Almanac" for 1829, are *all wrong*; though the encomiasts of the Society persisted in affirming in every newspaper and publication *to which they could get access*, that they were *all right*. 4th. (p. 59) That the times of high-water in "The British Almanac" for 1830, are computed from inadequate data, (which is exactly what we asserted before this "Companion" appeared,) and that (p. 62) the Society *cannot vouch for their accuracy*. And, 5th. "That the results obtained present a very remarkable coincidence between *theory and observation*" (p. 64); but *that, nevertheless*, (p. 52) ALL the observations are *decidedly and essentially inaccurate*, being scarcely ever to be relied upon within *ten* or *fifteen* minutes! Bravo!! Mr. Lubbock, Fellow of the Royal and Linnæan Societies, and Tide-computer to the "Society for the Diffusion of Useful Knowledge!" Better far it would have been had your brother superintendents trusted to the virtue of the "guinea-fee," and preferred a mathematical-usher, with his grey stockings, to all the Lubbocks of Lombard-street.

SOLUTIONS OF MR. MACKINNON'S ALGEBRAIC QUESTIONS, PROPOSED IN NO. 294.

Question First.

By Mr. Mathew Forster, Pupil at Mansion-House School, Hammersmith.

Given $x^2+xy+y^2=52$, and $xy+x^2=8$.

From the 2nd equation we have $y=\frac{x^2+8}{x}$ ∴ by substitution the 1st equation becomes $x^2+x^2+8+\frac{x^4+16x^2+64}{x^2}=52$. Clearing of fractions, &c. $3x^4-28x^2+64=0$, and this equation by decomposition becomes $(x^2-4)(3x^2-16)=0$ ∴ $x^2=4$, and $x=\pm 2$; also $3x^2=16$ ∴ $x=\pm\frac{4}{\sqrt{3}}=\pm\frac{4}{3}\sqrt{3}$: hence $y=\frac{x^2+8}{x}=\pm 6$, or $\pm\frac{10}{3}\sqrt{3}$.

Question Second.

By Mr. Thomas Hughes, Pupil at the above School.

Given $x^2-2xy-y^2=31$, and $\frac{1}{2}x^2+2xy-y^2=101$.

Subtracting the 1st equation from the 2nd, we have $4xy-\frac{1}{2}x^2=70$ ∴ $y=\frac{140+x^2}{8x}$: also by adding the two equations together, we have $1\frac{1}{2}x^2-2y^2=132$, or $3x^2-4y^2=264$ ∴ By substitution $3x^2-\frac{(19600+280x^2+x^4)}{16x^2}=264$; clearing of fractions, &c. $47x^4-4504x^2-19600=0$; and by decomposition we have (x^2-100)

$47x^2 + 196) = o \therefore x = \pm 10$, also $47x^2 = -196 \therefore x = \pm\sqrt{\frac{-196}{47}}$; and this value of x is impossible $\therefore x$ has only two possible roots; viz. $\pm 10 \therefore y = \frac{140 + x^2}{8x} = \pm 3$.

Question Third.

By Mr. Mathew Forster.

Given $x^4 - 2x^3 + x = 132$. By transposition $x^4 - 2x^3 + x - 132 = o$, and by decomposition the equation becomes $(x-4), (x+3), (x^2 - x + 11) = o \therefore x = 4$ or -3; and by assuming $x^2 - x + 11 = o$, the other two values of x will be found to be impossible; viz. $x = \frac{1}{2}(1 \pm \sqrt{-43})$.

The ingenious proposer of the three preceding problems requires that they shall be solved by simple equations, although they are all evidently of the biquadratic form. Had no such conditions been imposed, they might have been all solved by quadratics. The method of solving the two first in that way is perfectly obvious from this, that the final equations $3x^4 - 28x^3 + 64 = o$, and $47x^4 - 4504x^3 - 19600 = o$. The third question, which is a little more difficult, may be solved as follows:

Since $x^4 - 2x^3 + x = 132$; add $\frac{1}{4}$ to both sides of the equation $\therefore x^4 - 2x^3 + x + \frac{1}{4} = \frac{529}{4}$. Extracting the square root $x^2 - x - \frac{1}{2} = \pm\frac{23}{2} \therefore x^2 - x = 12$ or -11. Completing the square $x^2 - x + \frac{1}{4} = \frac{49}{4}$ or $-\frac{43}{4}$. Extracting the square root $x - \frac{1}{2} = \pm\frac{7}{2}$ or $\pm\frac{1}{2}\sqrt{-43} \therefore x = \frac{1}{2} \pm \frac{7}{2}$ or $\frac{1}{2} \pm \frac{1}{2}\sqrt{-43} = 4$ or -3 or $\frac{1}{2}(1 \pm \sqrt{-43})$.

THE ALGEBRAIC EXERCISE, NO. 316, p. 13.

A mathematical friend writes to us of this Exercise in these terms: "I could scarcely refrain a smile at the enunciation of Δ, the ingenious proposer, that this demonstration has been intended 'for *young beginners*.' In my humble opinion, such an exercise is quite sufficient to puzzle many who may be styled even veterans in the mathematics." There must be some truth, we suspect, in this remark; for though the question has been now three months before our readers, we have received but one answer to it—from Mr. J. Gilbert, jun. That answer, however, is very elaborate and correct; and but for its great length, we should at once lay it before our readers. It seems to us that it may, without difficulty, be brought within the limits of half a page; and if Mr. Gilbert will favour us with such an abridgment of it, we shall gladly give it a place.

ON THE PROMOTION OF COMBUSTION BY FORCING AIR THROUGH FIRE, AND THE ECONOMICAL APPLICATION OF THE HEAT THUS PRODUCED TO THE GENERATION OF STEAM. BY MR. WILLIAM GILMAN, CIVIL ENGINEER.

(Concluded from our last Number, p. 261.)

The preceding plans and their modifications open a wide field for ingenious, useful, and valuable appropriations of the heat that has hitherto been almost entirely neglected. Of some which have been actually carried into effect, I will proceed to give an account; but I must first observe, that as the plans are applicable to all high-pressure engines, whether worked by pure vapour or by the compound elastic fluid, after such steam or fluid has performed its office in an engine, it may be applied most advantageously to the purposes of heating, drying, &c. This I have put in practice successfully, at an extensive paper-mill, drawing and card-board manufactory, a short distance from London, where the steam from the eduction-pipe of a ten-horse engine that I lately erected on the premises, is delivered by an appropriate apparatus to the steam-pipes, which convey it to the work-rooms and drying-lofts, containing many hundred feet surface of pipes, most of them in detached buildings, and at considerable distance from the engine. The steam is so

applied to boil the paste at upwards of one hundred feet distance, to heating the stuff in the vats, the cylinders of the paper-drying machine, &c.; all this is performed, and the pressure of the steam regulated to the greatest nicety, at a loss of less than *one-tenth* of the power of the engine. Hence at this small cost the whole of the steam passing through the engine, or, in other words, steam equal to the power of ten horses, is rendered available to such purposes as those above-mentioned. The resistance indeed of the steam to the action of the engine, when thus applied, seems to be less than what, by calculating the difference between the pressure of the steam in the pipes and that of the atmosphere, the engine really ought to feel. The circumstance may be accounted for thus:—the steam issuing from the eduction-pipe is resisted by the air in a greater degree than the mere atmospheric weight, on account of the velocity with which it makes its exit; but the steam, though it may be a few pounds above atmospheric pressure, being subject to continual condensation throughout the whole length of pipes, cylinders, &c. a regular flow is consequently the result. Hence the resistance of the steam to the piston is comparatively less than when exposed to atmospheric resistance; and it may be a question whether if, were it not for the unavoidable number of elbows in the pipes, and the steam being much wire-drawn in some places, through inch and three-quarter inch gas pipes and cocks fixed in the buildings many years ago, the resistance would not be so much less, that steam of three pounds above atmospheric pressure would scarcely be felt, if at all, by the engine. And when it is considered that the resistance of the steam so appropriated causes no additional stress on the *working gear* of the engine, but that such stress is wholly confined to the *two sides of the piston*, it will readily be perceived that there is no difficulty in applying the plan to any existing high-pressure engine for the purpose of effecting the same objects, or for boiling water, or any of the like purposes. Any small loss *of power by* such appropriation, is of course easily made up by generating the steam in the boiler at a few pounds per inch higher.

I will now proceed to the manner of appropriating the heat arrested at the termination of the flues in the several modifications. The elastic fluid generated in the separate vessel of water into which the products of combustion are directly forced, as described in the first modification, may be applied to the greatest advantage to work the blowing-apparatus, independent of the engine, as this will carry on combustion and keep up the steam during any temporary stoppage of the engine. In this case, however, there ought to be such a length of flue intervening between the generator and water-vessel as would take up all but a sufficiency of heat to generate a fluid of adequate power to work such apparatus; and the fluid when it has performed its office may be applied to heating and other useful purposes in the manner above-described. By this arrangement pure condensible steam is procured, from which the utmost profit steam can give may be obtained by using it expansively in a high-pressure condensing-engine of one steam cylinder.

Of the second modification I scarcely need observe, that it is capable, like the above, of generating either high or low condensible steam; and the vapour and heated air arising from the water in which the flue terminates is also capable of being appropriated to most of the purposes of heating, drying, &c., to which the steam from the eduction-pipe of an engine is applicable at low pressures, if circumstances require. The first modification, by the supposed additional intervening flue between the generator and vessel of water, may be considered to merge into the second modification; but the form as first described, and referred to in the drawings, is the form in which it was used.

What has been said of the capabilities of the second applies likewise in a great measure to the last modification; for though the creating a partial vacuum over the surface of the water in which the flue terminates necessarily causes the compound fluid rising

om to be of an elasticity infe- that of the atmosphere, yet ie assistance of the exhausting- tus it may be rendered appli- o most of the above-described es.

value of the heat obtained he steam after passing through gine, and the elastic fluid at the ation of the generator or boiler- ust depend of course entirely necessities of the establishment ch the engine is erected; but it taking this at all into ac- I think it will be manifest that veral plans are capable of gene- power with the smallest quan- fuel possible, and possess the ainent quality of destroying the and rendering a chimney to- nnecessary. The mode adopt- the last modification of obtain- draught by an exhausting-appa- is particularly adapted to the se of destroying the smoke of ag furnaces where there is an e by which the apparatus can be n action; and as I believe it to tirely free from the objections to most of the plans hitherto pro- for effecting so desirable an ob- liable, it merits the particular ion of the proprietors of the nu- as establishments, especially in on and other large towns, whose nse volumes of smoke render at present a nuisance to the neighbourhood in which they situated.

Yours, &c.

WILLIAM GILMAN.

st cliffe-highway.

S.—I perceive I have omitted to , that it is not absolutely neces- that the exhausting apparatus ld be placed *immediately* over the ce of the water, as described in st modification, as such appara- may be fixed under the engine- n, and worked thereby, or by a k in any other convenient situa- and connected to the chamber e the water-surface by a suction- r also, that if the heated water, hich either of the flues terminates, quired for any purpose for which not fitted by reason of its impu- through its retention of the car- eous matter, such impurity may be in a great measure remedied, by causing the vapour and gases rising from its surface to flow into a second vessel, in like manner to that of the first; which water may be used for feeding the boiler, and many other purposes. The loss of heat, by using the second vessel, will be insignificant.

[We mentioned generally last week the obvious similarity between Mr. Gilman's plans and those of Messrs. Braithwaite and Ericsson. This similarity is not confined to the plan of gaining heat by means of forced air, but extends also to the mode of producing a draught or current of air by means of an air-exhausting apparatus at the end of the furnace-flue. In the specification of Messrs. Braithwaite and Ericsson's patent, it is stated that their invention "consists in generating steam in a boiler, wherein the capacity of the flue is too small to allow a sufficient quantity of heated air to pass through in a given time by the mere agency of what is commonly called atmospheric draught, and to which flue therefore we attach *either* an air-forcing apparatus at the furnace end, (as in "The Novelty,") or *an air-exhausting apparatus at the other end of the flue*, in order by these mechanical means to compel the required quantity of heated air to pass through the flue in a given time." With whom the merit of *priority* lies we do not presume to say, and have not, in truth, the means before us of determining; for though Messrs. Braithwaite and Ericsson's patent is, we believe, of a more recent date than the invention described by Mr. Gilman, it is not always from the date of a patent that the date of the discovery included in it, is to be inferred. Messrs. Braithwaite and Ericsson will probably favour us with some farther information on the subject.—EDIT. M. M.]

MINOR CORRESPONDENCE.

The Almanacs for 1830.—Sir, In the list of the magistracy of London, given in "The British Almanac," page 46, after the "Recorder, Newman Knowlys, Esq.," there appears the "Common Sergeant, T. Denman, Esq." I believe this is the first time the Common Sergeant has been included in such a list; but as he sometimes acts magisterially, I am not disposed to

question the propriety of the addition. If it is, however, right to include the Common Sergeant, on this account would it not have been still more so to include the *Deputy Recorder*, Mr. Sergeant Arabin? And what good reason can the compilers of "The British" assign for giving the one a place and excluding the other? Surely it cannot be because Mr. Common Sergeant happens to be a member of the Committee of *Superintendence*, under whose auspices this almanac is issued to the world; or because Mr. Sergeant Arabin happens to be the rival of Mr. Denman for the reversion of the Recordership! I wait for a reply.

I am, &c. CIVIS.

Wood of Farringdon Within, Dec. 2, 1829.

[The suppression of Mr. Sergeant Arabin's name is certainly very indecorous; but we must state at once our firm conviction, that neither the Common Sergeant nor the Committee of which he is a member have had any thing whatever to do with it. Mr. Denman, in particular, is by far too high-minded and honourable a man to countenance so underhand a method of keeping a rival's pretensions out of public view: it is evidently the device of some *tool*, who thinks by this means to curry favour with his employers.—EDITR. M. M.]

Almanacs for 1830.—Sir, Relying on your assertion that the *Englishman* "contains at least one-third more matter than the *British*," I resolved that the *Englishman* should be my almanac for the ensuing year; but after purchasing a copy, I was surprised to read in a critical notice of both almanacs, which appeared in that respectable journal, *The Times*, that the "arrangement" of the *British* is fully better than the other, and its articles of information "*more numerous*." I immediately concluded (will you pardon me?) that you had given a false character of your "favourite;" but to make sure how the fact stood, I put it in my pocket, and called on a friend who takes in the *British*, and every thing published by the Useful Knowledge Society, in order to make a fair comparison of the one with the other. We have accordingly gone through them page by page, and the result, which it is but fair you should be made acquainted with, is briefly this:—The number of distinct "articles of information" in the *British* is *eighty-five*; in the *Englishman*—*two hundred and seven!!!* *The Times* has no doubt been imposed upon by the artful manner in which the table of contents in the *British* has been drawn up. The Calendar, for example, which passes for one article in the *Englishman* (as it ought), is there split into twelve!

I am, Sir, your constant reader,

PETER PARTICULAR.

Sir,—You are incorrect in your correction of the *Englishman's Almanac* in regard to the obligation on the Speaker of the House of Commons to adjourn the House at four o'clock if forty Members are not then present. The Speaker counts the Members silently to himself as they come in, and unless the number of forty is made up when the clock strikes four, he invariably declares an adjournment.

I am, Sir, yours respectfully,

Pall Mall, Dec. 3, 1829. M. P.

[We find on farther inquiry that the practice is as our correspondent states; and have to apologise to the compilers of the *Englishman* for our impeachment of their accuracy on this point.—EDITR.]

Sir,—You who pretend to know so much about how almanacs should be written, will perhaps be able to say whether it is any part of the business of an almanac-maker to indulge in impertinent sneers at institutions patronised by *some of the first* characters in the country. In the *Tradesman's and Mechanic's Almanac* there is a notice of that excellent establishment the National Repository, the merits of which are thus abruptly disposed of:—"This would have been an admirable institution for the commencement of the *eighteenth* century!" The writer might at least have favoured his readers with a reason for this presumptuous assertion.

I am, &c. L. U. T.

[The writer of the notice in the *Tradesman* is quite correct. The Repository is, at the very least, a hundred years too late.—EDITR. M. M.]

Jackson's Studs for Boots and Shoes.—"Wm. Kingsnorth, of 31, Smith-street, Northampton-square, Carpenter," desires to corroborate by his testimony the great durability and economy of shoes provided with these studs, which he pronounces from experience to be greatly superior to "either metal heels, nails, or quarridon." We know Mr. Kingsnorth to be an old and respectable member of his craft, and attach great weight to his recommendation.

INTERIM NOTICES.

"Ingenious but Poor." The mode and expense of taking out a patent for a medicine are the same as for any thing else. Next Session of Parliament will probably decide whether there is to be any reform in either respect.

Mr. Steele promises to send us shortly a letter on a subject which he justly describes as "of "great general importance, not hardly to Great Britain and Ireland, but to every country in Europe that sends ships on the Atlantic towards the United States of America, as well as to the American States themselves;" namely, "the formation of an ASYLUM HARBOUR at Carrickaholt, near the mouth of the Shannon."—It is matter of notoriety that a great many ships are lost annually for the want of such a port of refuge.

We overlooked the concluding part of Mr. Hopwood's last letter till it was too late to do as he directed.

The series of papers offered by Brachstone will be acceptable.

T. F. M. deserves great praise.—We shall give his letter and the explanations he requests in an early number.

We presume that Mr. Murdoch and Mr. Hopwood will agree with us in thinking that the letters, inserted in our 329th Number, from Mr. Gilman and R. C. jun., render any farther exposition of the fallacy of the plan for a Self-acting Railway Carriage unnecessary.

Communications received from Mr. Thomas Davy—A. B.—J. R.—Caleb Mainspring—Investigator—Mr. W. Rickett—C. B—J. P. W.—Mr. Day—James C.—E. W. G.—Mr. Baddeley—G. F. S.—Mr. Hebert.

Errata.—In the description of the coach-makers' klam, vol. xi. p. 328, the bow is described as 5 feet 8 inches; it should have been $\frac{5}{8}$ of an inch.

P. 205, col. 1, l. 8, for "B?," read "BE."

———, l. 9 and 10, for "GH" read "DC."

P. 256, col. 2, l. 38, for "experiment," read "expedient."

P. 260, col. 1, l. 19, for "the nitrogen then charged with heat," read "the heat thus absorbed by the nitrogen."

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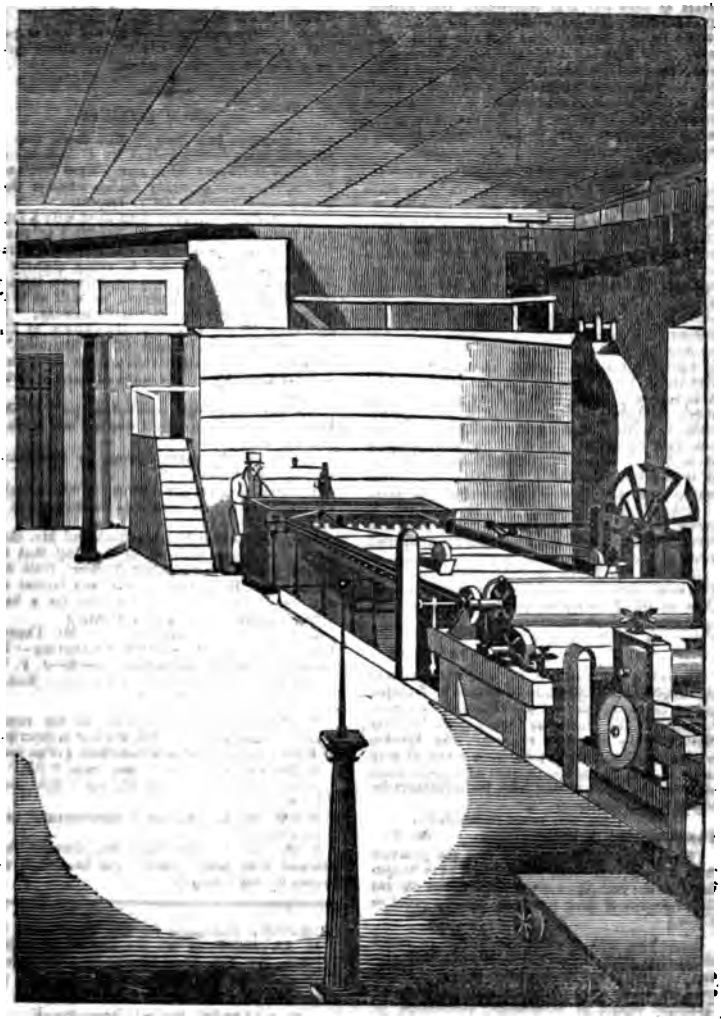
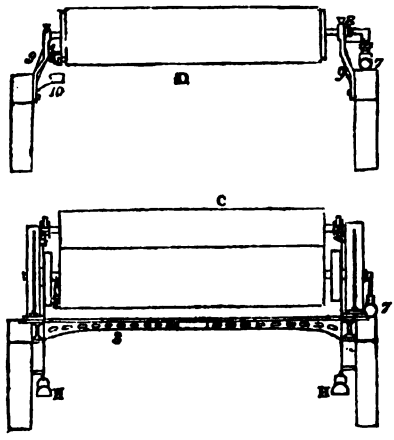
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 332.] SATURDAY, DECEMBER 19, 1829. [Price 3d.

RUSSIAN IMPERIAL PAPER MANUFACTORY.





DESCRIPTION OF A PAPER-DRYING APPARATUS EMPLOYED AT THE IMPERIAL PAPER-MILL OF PETERHOFF, IN RUSSIA, INVENTED BY MR. WILLIAM REED.

(Concluded from our last No. p. 275.)

D is a section of the thin copper rollers, which are only hammered by a good coppersmith. Brass ends, turned and soldered in the four rollers carrying the endless felt, have edges cast on a little lower to allow the double edge of felt to rest on, as it requires guide wheels—three pair on each side—to keep it stretched. The reels E are round or square, as required (flat reels we have thrown away).

When the dry paper is wound about 500 times, we cut it off from the reel with knives made of handsaws, backed with a piece of sheet-iron to keep them stiff. Four at a time in use will last a year, if good.

It may be as well to notice, that in making the first pair of copper rollers, marked No. 2, the copper must be full a quarter and sixteenth brazed and hammered true; otherwise, in turning, the slide-tool will find its way through it before it is round. The brass-tube gudgeons are let in *about* two inches into the end; drove very tight, and well soldered; because, on account of the great distance from the bearing required by the driving riggers and valve for escape of condensed water, they would be apt to get slack. I likewise screwed copper ⅛ screws through the tube and brass end, and they are now as firm as the first day. At the delivery from the clarionet-valve there is a small tube with a hole in its side to guide or prevent the water splashing or wetting the paper as it falls into the trough marked No. 10. The steam-rollers, felt-drum, reels, &c., are all driven by straps from the machine-cylinders marked No. 1.

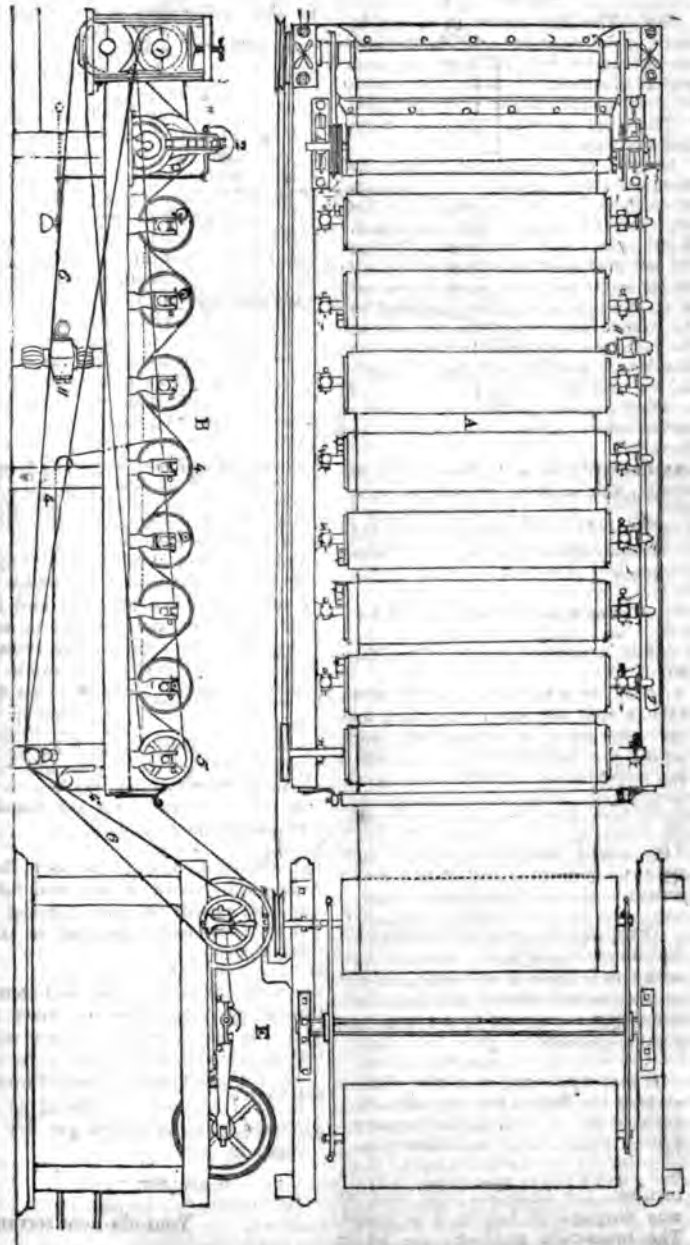
The cost of a set of such steam-rollers is about £250, without the boiler; copper in sheets being 11*d.* per lb. and cast-brass 16*d.* to 1*s.* 8*d.* per lb.

I should have mentioned that the cast-iron forked bearings, No. 9, have on the top a piece of iron with a stout wire pin to keep the roller in its place, and likewise a small funnel for holding suet—it not being so soon melted. If the rollers get dry they soon cut.

I am, Sir,

Your obedient servant,

WILLIAM REED.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MESSRS. BRAITHWAITE AND ERICSSON'S BOILER.

SIR,—The last attack upon me by your *good-tempered* and *disinterested* correspondent, "F," affords the most perfect illustration that I ever met with of that homely proverb, which says, "There are none so blind as those that *won't* see."

In spite of common sense, and the most self-evident truths, "F" persists in endeavouring to deceive the public into the belief, that the boiler in Messrs. Braithwaite and Ericsson's carriage did *not* give way, notwithstanding *all the hot water and steam were forced out of it*, through an aperture produced by the excessive heat to which that part of the boiler was subjected! and that the blast which is solely used for *augmenting the temperature* of the furnace, had no effect whatever in producing the disastrous result, which occasioned "The Novelty" being withdrawn from the late Railway contest! Now, I would inquire, whether it be *possible* to utter more gross and palpable nonsense? And, I would ask in what light ought we to regard the conduct of "F," who charges *me* with "substituting fiction for fact," and in "persisting in thrice refuted error most pertinaciously," because I have maintained (and shall ever maintain) the contrary to have been the fact.

If "F" be a man of any experience in the matter on which he writes, he must also know well that wherever blowing apparatuses have been previously employed for exciting the fires of steam-engine boilers, they have uniformly been discarded, on account of their occasioning such a rapid oxidation of the metal. Patch after patch has been "most pertinaciously" laid over the same hole, until the general weakness rendered farther patching impossible. This was found to be so troublesome and expensive, and to increase the liability to explosion so considerably, as to lead to the general abandonment of blowing machines. I do not mean to assert that it is impossible so to manage a blast as to render its destructive tendency nearly uniform over the whole surface of the boiler, and by such arrangement obtain advantages for many purposes, which would more than compensate for the early wearing out of the boiler; and I think, Mr. Editor, when you shall have observed the manner in which Messrs. Anderson and James's boiler is fixed, and that the draught of *air is so managed* as to cause every tube to be enveloped by flame, you will be of opinion that a blast might be applied to that boiler without producing any other injurious effect, than the early wearing of it out. Should any part of the tubes become "accidentally" not covered with water, as was the case with "The Novelty," no fears need be entertained on that account for personal safety. But the safe application of a blast to boilers having steam chambers of large capacity, is one of great difficulty; and I have no hesitation in appealing to the good sense of your practical readers, that the manner in which the blast is applied to Messrs. Braithwaite and Ericsson's boiler is as bad as it can well be, which results from the form of the boiler. In boilers of the more common construction, the current of heated air and flame is greatly weakened in its effects before it impinges upon any particular point, owing to the flames taking a longer course in a direct line before they are turned by a bend in the flue, in another direction; but in Messrs. Braithwaite and Ericsson's boiler, it will be perceived (on a reference to the section given in a previous number of the "Mechanics' Magazine") that the strongest flame from the furnace makes a sudden turn horizontally, close above the fuel, and the heat is in consequence chiefly concentrated at the part of the boiler marked *a*, on which it impinges in the manner of a blow-pipe. Every sensible man must, I think, admit this to be a great defect in Messrs. Braithwaite and Ericsson's arrangement, which is otherwise well calculated for making the utmost of fuel, and in this respect it certainly deserves every commendation. I hope, Sir, should any of your numerous Correspondents do me the favour of correcting any errors that I may have fallen into, that he will have the kindness to put his *name* to it; because we shall then be able to see if the statements of the anonymous "F," and the "respectable Engineer" in ambuscade, (whom you quoted in the note appended to "F's." letter) meet with any support from PRACTICAL MEN.

I remain, Sir, respectfully, your obedient servant,

L. HEBERT.

20, *Paternoster-row*,
Dec. 7, 1829.

[We have before expressed an opinion that it is our respected contemporary, and not his opponents, who have taken a wrong view of this case; and we must

say we see nothing in his present reasoning to induce us to change that opinion. The accident which happened to "The Novelty" is precisely analogous to one of every-day occurrence in common life. Place a copper kettle, *with water in it*, on a strong fire, and while there is water in it no perceptible injury will ensue. Place the same kettle on the fire, without any water in it, and a hole will be burned through it in an instant. Would Mr. Hebert say that it is the kettle which is in fault here? We do not suppose he would; and yet it is an absurdity of precisely the same kind for which he contends in regard to "The Novelty."—ED. M. M.]

COMPANION TO THE ALMANAC — JEWISH CALENDAR.

Sir,—I thought that you was too hard upon the Society formed for the Diffusion of Knowledge and Encouragement of Literature, by underselling the booksellers, and leaving them nothing to do; but I have now found to my cost that you are right. In the advertisement about their Companion to the Almanac, I saw a little mention of a Jewish Calendar, which I thought I should like to possess. I said to my neighbour, Reuben Cohen, 'Do you think it will be all right, and worth the monies?' 'Fear not that,' replied he: 'is there not a Committee of Superintendence to which belong Isaac Lyon Goldsmid and Benjamin Gompertz, both true men of our nation; yea, Israelites indeed?' Well, then: I bought the Companion, thinking half-a-crown would be well laid out to have all our Feasts correctly ranged in print for the whole year before-hand. But, Sir, I now find, too late, that my monies are gone for nothing, that the Society is not the Diffusion Society, but the Fudge and Delusion Society, and that my two Israelitish brethren have slept at their post. And now, though it be the warning of an indignant brother, let me remind them, that when King Ahab suffered himself to be seduced by false prophets, he was slain at Ramoth-Gilead; yea, and the dogs licked up his blood. Sir, will you believe me when I assure you that in the Jewish Calendar, page 31, of the said half-crown book, there are three mistakes, and one feast omitted, in thirty-four lines? These people, Sir, cannot count the number of days in our month *Thebeth*; they omit our Festival on the 15th of *Shebat*; they put the 7th *and the 10th of* Thebeth on the wrong days; they put the 1st of *Nisan* on a wrong day; and they only make *thirteen days* between the 1st and the 15th. Excuse me, Sir; these people may make Almanacs for you, Gentiles, but we, Jews, are not to be thus humbugged out of our monies.

I am, Sir, yours,
NATHAN EMMANUEL.

24 of the month Chisleu,
Charles-street, Hounsditch.

THE BRITISH ALMANAC AND THE COMPANION TO THE ALMANAC FOR 1830.—MR. LUBBOCK'S DEALINGS WITH THE TIDES.

"The Queen of Night with vast command
Rules o'er the sea and half the land,
And over moist and crazy brains
In high spring-tides at midnight reigns."
HUDIBRAS.

We promised our readers we should return to Mr. Lubbock and his dealings with the tides; and, as the question at issue does not merely involve the scientific capabilities of that gentleman, and the fairness of the strong opinion we have pronounced respecting them, but is one of great interest to all men of investigation, we now hasten to redeem our pledge.

We know not whether Mr. Lubbock was appointed to undertake this recondite inquiry by those who sit in authority at the head of the Knowledge Diffusion Society, and who decree to each

"——— his province in the common toil."

Or whether with a spirited determination to outshine Newton and others who have dived into the intricacies of this matter—he comes self-devoted to the task. But in either case the result will be found *equally honourable* to Mr. Lubbock's intellectual powers, and to the Society in whose behalf he has thus signally exerted them.

We must confess that at first we were thrown into some dismay by the formidable exhibition of mathematical symbols with which Mr. Lubbock makes his advance into the field. We brushed off the dust and cobwebs from *Lecroix sur "Le Calcul Differential et de Calcul Intégral,"* determining to surmount all the difficulties which thwarted us twenty years ago, and to show that we too would reduce the tides to our beck, flourish about "integrales indeterminées," "données explicitement ou implicitement," and summon to our aid Taylor, D'Alembert, and Lagrange. But on second thoughts we

concluded, that a little common sense would serve better than a display of symbolic charlatanry, to place the matter in its true light, and render it intelligible to the bulk of our readers.

We make no apology for carrying out our strictures to some length. They relate to a phenomenon of daily occurrence and universal interest, which few persons, comparatively speaking, have minutely traced. Besides, as Mr. Lubbock is not very remarkable for the lucid arrangement of his materials, it is not easy to speak of them as they deserve in a small compass. Perhaps the task will be rendered less prolix if we separate our observations into two sections; giving

I. *Remarks on p. 6, of the "British Almanac."*

The "Mécanique Celeste" of Laplace is first quoted for an expression, from which it is said, "the time of high-water *can* be obtained" (meaning at London); and then we are told that "this *appears* to be *incorrect*, or at least *indistinct*; *it should be*" so and so. Now is not this rather a venturesome thing in a young gentleman who has not *yet* acquired the reputation of being at the head of British writers on physical astronomy? The authority of the illustrious Laplace—the most refined and profound of modern mathematicians—set aside by the brief *should be* of J. W. Lubbock, Esq, F. R. and L. S.!! The gentleman does not, to be sure, absolutely affirm that Laplace's expression is "incorrect, or at least indistinct;" he only asserts that it "*appears*" to be so. This is in your mock modesty style; than which few things are more offensive. Mr. Lubbock should make his election, and say manfully that in the formula in question Laplace is either *incorrect* or *unintelligible*. Let him not, as at p. 53, of the "Companion," skulk behind a doubt as to a misprint, and we have no apprehension but what the truth will soon appear.

We do not stop, at present, to vindicate the accuracy of this formula; for we hesitate not to say generally of Laplace's theory, that it is *not*, as Mr. Lubbock has given it, at all applicable to the state of the tides at London Bridge or the London Docks. Laplace would no more have thought of applying it to either of these localities than to Winandermere or Loch Katrine. Our readers are entitled to some proofs of this assertion. 1. Laplace's theory, beautiful as it is, is limited in its application *by the data* which supply the arbitrary quantities in his equations. These being taken from observations made in ports, principally in latitudes between 43° and 48½°—Brest especially, not far from 45°, (the cosine of whose double is *nothing*)—led to simplifications, which however safely they may do for Brest, *cannot* be correctly employed at London or even at the Nore. 2. Brest is exposed to the full tide of an open sea; London is more than 40 miles from the open sea. 3. The motion of the tidal wave at Brest has carried it over several hundred miles in the preceding hours; the tidal wave arrives at London Bridge after it has dragged along a comparatively slow and sinuous passage of 40 miles in 2 hours. 4. The tide at Brest is a simple tide; that at London not so. 5. At Brest the tide employs about ten *minutes* more in descending than in ascending;* at London the ascent occupies between 4 and 5 hours, the descent between 7 and 8. 6. At Brest the spring-tides rise about 19½ feet, the neap-tides 9½ feet * (less than a half); at London the spring-tides rise about 18½ feet, the neap-tides not quite 14 (nearly ¾ of the spring-tides). Other circumstances of dissimilarity between the phenomena of the tides at Brest and at London might be traced; but those we have cited will amply suffice to convince any thinking person, whether mathematician or not, that a theory depending *mainly* upon observations at Brest, cannot, without the utmost caution, or without considerable modifications, *if at all*, serve for the tides at London. *Men* may be influenced by public bodies and a phalanx of powerful names; but *mathematical theories* are not so easily fitted and moulded to purposes for which they were not originally intended.

Having thus shown the inutility of the quoted theorem (excepting always as a matter of mere parade), let us look a little at the table on the lower part of the same page, which is said to give "the number of minutes, which if the time of the moon's southing is on the left hand side is to be subtracted from, and if on the right hand side to be added to the time of the moon's southing + 1 hour 29 minutes;" the establishment of the port of the London Docks being supposed to be two hours. Of this table we have to remark—

1st. *That it is of no use to a computer of the times of high-water at London Bridge, or elsewhere, without the*

* See Biot, Astronomie de Physique, tom. ii. p. 544.

ephemeris of the moon's parallaxes for at least every day; and that such an ephemeris of parallaxes *is not given* by the Knowledge Diffusion Society either in their Almanac or their Companion. If they had followed the example of the despised Francis Moore, who fills up those spaces, which would be otherwise vacant, in his Calendar, with times of the rising and setting of the planets, they might have turned their fastidious omission of Saints days to some purpose, by filling the numerous blank spaces which have been thus occasioned in their Calendar with lunar parallaxes. As the matter now stands, a computer cannot use this table of Mr. Lubbock's without giving half-a-crown for "White's Ephemeris," or twice as much for the "Nautical Almanac." If any person, however, wishes simply to compute the high-water for London Bridge, or the London Docks, he may save himself the expense of purchasing either auxiliary: for—

2ndly, *Mr. Lubbock's table, even with the help of the lunar parallaxes*, IS ALTOGETHER UNFIT *for computing the high-water at London Docks, although actually employed for that purpose in getting up the computations exhibited in the British Almanac.* This in fact Mr. Lubbock admits (Companion, pp. 59, 61.) But there are other reasons for the inadequacy of this table, of which we suspect the learned gentleman has little notion. The tides in the Thames are always made up of *two*, and sometimes of *three* distinct lunar or luni-solar tides. As this assertion may startle some of our readers, as well as Mr. Lubbock, we will confirm it by a brief detail, in which our general accuracy may be confirmed by any one who will turn to Riddle's or Nories's tables, in their respective books of navigation. The tide which is occasioned by the joint influence of the two luminaries at new or full moon, and commencing (suppose) at noon, somewhere in the Atlantic, (the precise part, we need not speculate upon) arrives at Brest, at the Land's End, and on the West of Ireland between four and five o'clock. At the Land's End the great tidal stream is divided. One portion pursuing its way along the Irish Channel, meets another tidal stream at the North of Ireland; then, pursuing its course along the northernly Scotish coast, and falling in with other tidal portions from the Shetland and Orkney coasts, it proceeds along the eastern shores of Scotland and England. The other portion of tidal waters at the Land's End proceeds along the southern coast of England, until it meets the other stream. Where does the junction happen? The tide which is at the Land's End, say at half past four o'clock, will be found at Plymouth at 5h. 30m., at Torbay at 6h. 10m., at Weymouth at 5h. 30m., at St. Alban's Head at 7h. 30m., at Dunnose at 8h. 56m., at Brighton at 10h. 6m., at Rye at 10h. 36m., and at Dover before half past 11. Meanwhile the tide proceeding northernly, (and with *many accessions of earlier tides*,) will be at the Pentland Firth at 10h. 30m., at Banff at 11h. 30m., and at Peterhead about 12. So far, then, as the simultaneous operations of the luminaries are concerned, the coincident tides, for any one moment, must be sought between Rye and Margate in the south, and Banff and Peterhead in the north. Pursuing the northern portion, we shall find high-water at Montrose at 1h. 30m.; but that is, in fact, the high-water of the tide which precedes that which we have hitherto been tracing by 12 lunar hours. Let us pursue its course. It is at Berwick at 2h. 15m., at Sunderland at 3, at Scarborough at 4h. 30m., at Cromer at 6h. 45m., at Yarmouth Roads at 8h. 45m. Thence a portion of it flows directly across to the North Foreland; another portion (either of them being stronger than the southern branch of tide, on account of the accessions,) winds its way to the Nore, where it arrives about 12 o'clock, viz. 24 hours after its origin in the Atlantic; and at that moment *a third* tide may be rising, under the immediate influence of the moon, between the Nore and the northern coasts of Europe. The other branch, which goes across from the Suffolk to the Kentish coast, usually reaches Dover about a quarter of an hour before the southern tide, and being stronger, forces it backward for nearly half an hour. We have several proofs of this, but need only specify two. One of them the reader will find in Smeaton's Reports on Ramsgate Harbour,* where he refers to the influence of the two streams in modifying the time of high-water. The other is deduced from the *known fact* that the spring-tide at Rye is a tide *earlier* than the spring-tide at the Nore. Part of this complex tide also slides along the eastern shore of Kent, and works its way to the Nore. And now we should be glad to know to which of these two or three tides, whose confluence produces high-water at London

* Smeaton's Reports, vol. iii. p. 82.

Bridge, or the London Docks, we are to refer the numbers in Mr. Lubbock's table, which has led to this induction of particulars? Must we, when employing this table, take the moon's parallax, which agrees with her time of southing, just before any one high-water, or the southing for a tide earlier than that, or for two tides earlier? Or, are we to blend the parallaxes as the waters of the succeeding tides are blended? And, if so, in what manner, and by what rule? When it is recollected that a change of three minutes in the moon's parallax may cause a change of more than ten minutes in the time of high-water; it will be seen that these questions are not put in order to insinuate an apparent difficulty where none really exists, but are, on the contrary, of vital and paramount importance. Either the Society, or their physical astronomer, Mr. Lubbock, must give a complete and satisfactory answer to them—an answer bearing *practically* on the table itself; or the public will be forced to conclude that that table is of no more use than a table of *cloth measure or apothecaries' weight* would be for determining the periods of time for which it is given. We dwell more particularly upon this second ground of objection to the table, because the motion, setting, meeting, and receding of the tides are intimately connected with many points of civil engineering, and have never yet, as far as we are aware, been investigated with the minuteness they deserve. After all, however, we must not forget to remark with respect to this extraordinary table—

3dly. *That though from its position it seems to be an immediate consequence of Laplace's theorem, which precedes it* (and could precede it for no obvious purpose but to make that impression) *it depends on principles which were developed not by Laplace, but by Daniel Bernoulli before Laplace was born.* A table similar to Mr. L.'s in principle is inserted in *Bernoulli's Traite sur le flux et reflux de la Mer*, and may be found at page 165, vol. iii. of the Glasgow edition of the Jesuit's Newton. We should be well content to think Mr. Lubbock knows nothing of this unacknowledged resemblance, but both the writers we have just referred to are quoted by Mr. Lubbock himself in the "Companion."

On the whole, then, it may be asked, why was this table introduced at all, since it is confessedly and obviously useless? And why was it placed to seem to be what it is not—a straight-forward, *fair* deduction from Laplace? Are these things the result of pedantry, or of ignorance, or of an experiment to measure the gullibility of the British public, or of a mixture of all three?

The second section of these animadversions must be postponed until another week; and in the meanwhile, we beg it may be remembered that we are sounding the depths of the Knowledge Diffusion Society as to a matter of practical science in which they have undertaken to instruct the world.

(To be continued.)

TEMPERANCE SOCIETIES. — CHEAP BEER.

A great work of moral reformation has been recently begun in America, and has now happily reached our own shores. We allude to the institution of Temperance Societies for promoting the disuse of ardent spirits. No less than 500 of these Societies have lately been established throughout the United States, and at the commencement of the present year (1829), there is stated to have been 100,000 individuals in the American Republic who had publicly forsworn the sin of intemperance. This effect, too, has been brought about, as Professor Edgar, of Belfast, remarks, "not by legislative interference; not by legally prohibiting distillation and the use of spirituous liquors; nor by throwing heavy duties in the way of the poor—for all these would have been insufficient: the only remedy for the desolating evil of intemperance has been found in awakening the reason, the moral sense, and the piety of the community. All the efforts that have been made—efforts already crowned with unexpected and animating success—have consisted in earnest, affectionate appeals to the understanding and consciences of the people." Encouraged by the example thus set by the philanthropists of the United States, some well-wishers to the Irish people (who, without offence be it spoken, stand, next to the Americans, most in need of a reform in this particular) associated together a few months ago under the name of the "Dublin Temperance Society," for the purpose of collecting information on the subject, and laying it from

time to time before the public. Already half a dozen tracts have emanated from this Society, each embracing some different view of the evils of intemperance, and all of them very ably written; and Branch Societies have been formed at New Ross, Cookestown, Rathfriland, Drogheda, &c. The following vigorously sketched picture of that depraved condition of social life, which it is the object of this Society to reform, we quote from one of these tracts, written by Professor Edgar:—

"The evils of drunkenness are universally acknowledged. There is no necessity for entering into deep discussions respecting the causes of Ireland's misery. The chief cause is blazoned on the sign-board of every dram-shop—it looks forth from ten thousand bloated faces—it meets us wherever we turn, in hosts of destructive habits and practices. The poor-house, and infirmary, and gaol, are filled with its fruits; and its fresh graves are strewed every where in the place of the dead. Mothers drink, with infants hanging at their breasts; fathers drink, and let wives and families starve; children drink, after the example of their parents, and prepare themselves, in the company of drunkards, for becoming the scourge and curse of other generations. Drunken customs tyrannize every where; apprentices to all trades must drink; journeymen must be bullied, and ridiculed, and insulted, or drink. Every bargain is settled by drinking; every act of hospitality must commence with drinking; christenings must be drinking-matches; marriages must be celebrated with drinking; no wake would be deserving of the name which afforded no drinking; and to bury a man without drinking, would be giving him, in the opinion of many, the burial of a dog. Then, the sessions-house of each congregation must have its cupboard and its bottle, and after the sermon, and perhaps before it, the ruling elder is ready with the dram for the minister; wherever the minister goes, in his visitations, the bottle is ready; and, no matter how often he has drunk already, or how weak or hungry he may be, he must, in every house, *take a drop of something*. All this drinking is sanctioned by a community, who vainly imagine that intoxicating liquors are promoters of health and activity; and that hospitality and social intercourse could not exist without them."

We sincerely hope that the endeavours of Professor Edgar and his friends to amend this vicious state of things in the sister kingdom, will be crowned with speedy success; and that England and Scotland too will forthwith have their Temperance Societies, supported with equal energy and talent. We must notice, however, one or two features in the publications of the "Dublin Society," which we consider likely to lessen their usefulness, and would be glad therefore to see amended. In the first place, the intemperance they denounce is too exclusively the intemperance arising from the use of ardent spirits; as if beer could not be drank to excess as well as whisky or gin, or as if gluttony did not count its millions of victims as well as drunkenness. Secondly, they recommend no substitute for the pernicious liquors which they denounce; they do not *blame* the use of ale or beer, but they say nothing in favour of them, and thus leave it to be inferred that what the Society advocate is an entire abstinence from fermented as well as distilled liquors of every kind: an extent of reform which can scarcely be considered as practicable, and if practicable, not called for by any considerations either moral or physical. And, thirdly, they say nothing of the deplorable influence which the enormous duties on malt liquors, (175 per cent.!!!) and the comparatively trifling duties imposed on whisky and gin, have had in promoting the use of the latter—and that profligacy and wretchedness which invariably follow in their train.

The Society by insisting for too much, will expose themselves to the chance of accomplishing little or nothing. They should join their efforts to those of the many equally sincere friends of the people, who think that one of the surest practical means of weaning the multitude from the use of ardent spirits, is to provide them with a wholesome malt beverage at a cheap rate, and who are with this view striving to enforce on the Government and Legislature the urgent expediency of abolishing, or, at least, greatly reducing the present enormous taxes on malt and beer. "Earnest

and affectionate appeals," such as Mr. Edgar speaks of, are quite as much needed to prick the consciences of the governing as the governed; nor until an entire change takes place in our system of legislation, as it affects the sources of intemperance, can there be much likelihood of any general reform in habits which are in their worst excesses but the natural fruits of that system.

Following this article there is a communication from an esteemed Correspondent, which we earnestly recommend to the notice of our Dublin friends, and to the attention of the public at large. The Society could not forward the objects it has in view more effectually than by circulating it as widely as possible. It gives an account of the discovery of a new material from which beer almost if not quite as good as from malt may be manufactured for *one-fifth of the price*. The author of the discovery is a respectable surgeon in the north of England; on the correctness of whose statements every reliance may be placed.

CHEAP SUBSTITUTE FOR MALT.

Sir,—It is not from a desire to withhold any useful knowledge that I have thus long deferred fulfilling the promise I some time since made, to furnish you with a method of brewing beer at a much cheaper rate than is usually done. The article I use is well known to most people by the name of mangel-wurzel, and is, in *many respects*, well worth every person's attention. It is very easy to cultivate, and I will give some further account of it previous to the season for sowing. The process for brewing is, to take as many of the roots as you choose to brew, wash them well, slice them across, and fill any sized boiler with them, so cut; add as much water as the boiler will hold, and, if possible, lay a weight of some sort on the roots to keep them under the water; after boiling them for about an hour and a half, they may be taken out, well broken, and pressed, as the strongest part of the liquor remains in the roots. After they are well pressed, put the liquor that comes from them, and the water they *were boiled* in, together, and reduce, by *boiling, to* any strength you please; then put in what quantity of hops is thought necessary, and boil for one hour. Cool the liquor as quickly as possible, and put a sufficient quantity of yeast to work it, as ale is generally done.

After saying so much, it may be thought by some superfluous to add more; but as this is intended chiefly for those who have not been much in the habit of brewing, I will beg leave to give the process by which I have lately brewed. I took 150lb. of the roots, being the quantity my boiler would hold, boiled, bruised, and pressed, as above, adding one pound of hops, which I infused all night in some of the hot liquor; and by a saccharometer I have made, such as is recommended by Mr. Saddington, in vol. ix., page 361, of your very valuable Magazine, I reduced the liquor to the strength of about 28lb. of saccharine matter to the barrel of 36 gallons. I then boiled the hops in the liquor one hour, cooled it as soon as possible to 70 degrees Fahr., and then added one pound of good yeast, let it stand 24 hours, then beat it in, and again in 12 hours; I then took off all the yeast I could, after letting it stand six hours; in six hours more I again took all the yeast off, and tunned the beer, allowing it to work well out of the barrel. When done working, I put in a handful of the cold hops I reserved for the purpose, stirred them well in the barrel, and in a few hours bunged it down. The result is, 16 gallons of ale, apparently very strong, of a very fine flavour, and equal to any malt ale. The whole expense thereof does not exceed seven shillings, which is only 5½d. per gallon for ale which would not disgrace a nobleman's table. The refuse left from the press is an excellent food for pigs.

I am, Sir, &c.

HOMO.

Laceby, near Grimsby,
Dec. 3, 1829.

SOLUTION OF EQUATIONS OF ALL DIMENSIONS.

Sir,—Two or three weeks ago I purchased Wallace's "Elements of Algebra," lately published by Mr. Stuart, 139, Cheapside: at the end of which a rule is given for the solution of equations of all dimensions, said to have been discovered by Mr. Halbert, schoolmaster of Auchinleck, and published by him at Paisley, in 1789.

Being a novice in the algebraic art, notwithstanding the numerous examples given in Mr. Wallace's excellent little work, I have found it difficult in application; I would therefore esteem it a favour, if either the author or any of your numerous correspondents would favour the public, through the medium of your useful pages, with solutions by the above rule of the following; viz.

$x^3+9x^2+4x=1940$

$x^3+4x=1040$

$x^4-9x^2+6x-x=1590$, in all of which x will be found $=10$; and,

$x^3+3x^2+3x=39{,}303$, in which x will be found $=33$.

The publication of this with the answers you may receive, besides benefiting others, may prevent me again appearing in your columns under the title which I am obliged to subscribe myself,

I am, Sir,
Your obedient servant,
NOVICE.

Myddleton Square,
Dec. 1, 1829.

ON BREAKING OPEN HOUSES WHEN ON FIRE—IRON BRESTSUMMERS—AND NEW POLICE.

Sir,—In reply to the strictures on the "conduct of the new police in case of fire," contained in your 329th Number, permit me to say that I deny the *impropriety* of breaking open the doors and lower parts of a house on fire; and that, had the police-men been prevented by their instructions from so doing, much evil would inevitably have resulted.

As the circumstances attending the occurrence of accidental fires are in almost every case different, so necessarily must be the procedure of those persons whose duty it becomes to endeavour to suppress them. To give *definite* instructions that this, or that, shall—or shall not be done, in such varying cases as these, would be highly absurd. The Commissioners of the new Police have, therefore, only furnished their men with *general* and *discretionary* instructions—the only method their present arrangements will enable them safely to pursue.

I have frequently met with persons taking the same view of the case as your correspondent "J.S.S.;" but such persons have, like him, derived their information on this *subject*, from the imperfect, and generally incorrect statements of these accidents, furnished by the newspapers, from which no conclusion should be drawn.

The only fault is, where, after the doors, &c. have been broken open, good use is not made of the ingress so obtained. If the personal observation of "J.S.S." has ever extended to a case where mischief has resulted from persons breaking open the lower part of a house, when on fire, it must not be attributed to *that* circumstance, but to the absence of necessary means, or to the proper use of those means, to avail themselves of the opening so made.

Opening the lower part of a house admits a supply of fresh air to rush in, which assists the conflagration, and so far is an evil. But, on the contrary, an opening thus made permits the extent, situation, and probable direction of the fire to be correctly ascertained, and also greatly facilitates the steps taken to extinguish it. By it also the inmates may be aroused, assisted, or extricated, and very frequently a considerable portion of their property saved. An entrance having been obtained, the origin of the fire can be frequently ascertained and determined, whether wilful or accidental. On these several accounts, therefore, breaking open is a positive GOOD, and not so reprehensible a practice as many persons imagine.

To illustrate the matter by example, permit me to relate the following brief account of one or two fires which have occurred lately, and at which the practice censured by "J.S.S." was resorted to:—

About three o'clock in the morning of the 17th October last, a fire broke out in Rood-lane, Fenchurch-street. Upon the arrival of the beautiful engine belonging to St. Edmund's parish, (see vol. xi, page 7,) the engineer, L. Rogers, tore down the shutters, and displayed the shop (a carpenter's) one vivid mass of fire, the story-posts and brestsummer just lighting up. The before-named engine was set to work in gallant style; and notwithstanding the highly inflammable nature of the materials on which the fire was preying, consisting of thin deals, boxes, shavings, &c., the whole of the fire in that part of the premises was quickly extinguished, and prevented from entering the dwelling above. This engine not being properly supported by those sooner on the spot, the fire raged for some time, and did considerable damage in the rear of the premises. But the prompt exertions of the firemen of the several insurance offices soon effected

the total suppression of the conflagration. As an eye-witness of the above transaction, I can bear ample testimony to the great advantage obtained in this case by opening the front of the premises. Without it, in fact, a great waste of labour and consequent loss of effect must inevitably have ensued.

Again, no longer ago than last Thursday, the 3rd instant, about one o'clock in the morning, a fire was discovered in the old-established patent-medicine warehouse, under the south piazza of the Royal Exchange. The watchmen immediately broke open the premises, and succeeded in putting out the fire.

In each of these cases the blame, *if any*, attaches to the *old* police; in the following to the *new*:—

At the late serious conflagration at the corner of Well-street and Oxford-street, the door was broken open, but from the highly combustible nature of the stock, and from the length of time it had been burning, the fire had attained such a head when discovered, that all efforts to suppress it were for a length of time unavailing. In this case the door was broken open too late to do either good or harm. Not so, however, in the following instance, which occurred on the 24th of November last, at the White Hart public-house, the corner of Portpool-lane and Leather-lane, which was discovered to be on fire by police officer Birbeck, No. 69, E division. Having alarmed the inmates, he burst open the door, and discovered the bar enveloped in flames, the fury of which was greatly increased by the quantity of spirits and other inflammable matter with which that part abounded. Birbeck being reinforced by more of his party, headed by their serjeant, and aided by a plentiful supply of water, they succeeded in extinguishing the fire in about fifteen minutes.

While such results as these attend the breaking open the lower part of houses, when on fire, GOD forbid that any instructions should be issued to prevent it.

Having always taken considerable interest in these matters, I could fill the whole of this and the next week's Magazine with similar accounts; the above, however, are quite sufficient to support the view I have taken of this subject.

The new police have not yet had sufficient experience to render them so perfect as they promise, and as we may reasonably expect them to be. They are, for the most part, strong, active, and *intelligent* men; and I hope that by-and by they will assume still more and more the character of a FIRE POLICE; and that they will be furnished with the necessary apparatus, of which they are at present destitute, to render their exertions more powerful, and consequently more effectual.

Though I am by no means surprised at the *opinion* entertained by "J. S. S." yet I am so that it should be *held* by *him*, when I remember it is not yet two years since he proposed, and strongly advocated breaking into houses on fire, aye, even through brick-walls! See vol. ix. pp. 67 and 311.

I should be very sorry for your correspondent to suppose that I have combated his idea from any spirit of contradiction. On the contrary, it is only from a conviction—a conviction founded on practical experience—that the view he has taken is erroneous; and that his communication at page 272, if suffered to pass unnoticed, is calculated to seriously injure that cause, of which I am confident he is a well-wisher.

With regard to the objection which "J. S. S." has advanced against the use of iron brestsummers, I shall only observe, that although the case he has adduced may, perhaps, be within the bounds of *possibility*, yet it is so very, very far removed from *probability*, that I consider any further comment unnecessary. I have, upon a former occasion, urged the necessity that we should possess correct ideas on the all-interesting subject of fire-suppression, and can only now offer the same as an apology for this intrusion on your columns.

I am, Sir,
Yours respectfully,
WM. BADDELEY, Jun.

DARBY'S FIRE AND BURGLARY ALARM.

Sir,—I have read with much pleasure the numerous communications on the subject of "fire-escapes," inserted in your Magazine: but if it is important to have the means of escape, how much more important is it to know, when a fire has taken place in a house, so that persons may have an opportunity of availing themselves of such inventions?

I own it is for a double purpose (but, believe me, a pardonable one) that I call the attention of your readers to Darby's patent fire and burglary alarm. It is the invention of an honest, industrious man, who is

g all the ills attendant on the
of life, trade, health, and cir-
nces. He has been a house-
in the parish of St. Luke,
set, for upwards of forty-five
nd has been compelled lately
it the indulgence of the paro-
uthorities to be excused his
1 the ground of poverty! Yet,
itor, he is the possessor of a
which in other hands might
t once beneficial to the public
e possessor. It is with this
ir, that I send you a model of
ention, by which you will per-
hat it would not be an objec-
e piece of furniture in a sleep-
m, having the appearance of
robe; wires connected with it
ached to the various doors and
s, and in the event of thieves
g in, or fire taking place, a
rms the inmates of the house,
the same instant it lights a
and presents a tablet showing
me of the apartment where
of those disagreeable agents
rrying on their work of de-
n. I sincerely hope it may
he eyes of some liberal insu-
ompany, or some individual
eans and inclination to pa-
it; in which case, I think in
ere is scarcely a gentleman's
or public establishment but
have one.

I am, Sir,

A MECHANIC.

ry-place, Dec. 8, 1829.

model of this fire-alarm is
our office for inspection. It is
us and simple, and we hope
neet with the patronage it
—EDIT.]

SION OF CANALS INTO RAIL-WAYS.

—In a note at p. 211, of your
Number, it is remarked, "that
's work on a rail-road may be
t to approximate much nearer
vork on a canal than perhaps
n generally imagined." The
sment of Mr. Winans in the
ction of rail-wheels may make
ference less than what you
n in your note to the few lines
of mine you have thought worth insertion in your 329th Number. Be that as it may, I cannot but think that if it can be shown that, by a *greater* power of steam, you can propel a given quantity of *heavy* goods at a *cheaper* rate than can be effected by boats drawn by horses, this greater power will be employed, and the canal is left without any advantage whatever over the railway. It may be true, in one point of view, that for some species of heavy goods, a greater speed than two miles "is not wanted," yet the most economical mode of conveyance will certainly be adopted, and in a calculation of expense the consideration of *time* must by no means be lost sight of. Suppose the same quantity of coals to be drawn by a steam-engine a given distance in 6 hours, as it would take 2 horses to accomplish in 24 hours, moving at the rate of 2 miles an hour; you have on one side to compute the wear and tear of the engine and rails, a few shillings for fuel, and 6 hours' wages of the engine-man—on the other, you have to pay the bargeman and driver their 2 days' wages, providing food for your 2 horses during the same time, or what would be equal to the feed of 8 horses for 6 hours, and it is dispatch alone which makes all this difference.

I think also that there are many objections and obstacles to the laying down rail-roads on the sides of canals; for, in the first place, it does not appear likely that canal proprietors generally are *at present* possessed of a strip of land wide enough to form a commodious double rail-road upon, especially on that side of the canal not occupied by the towing-path; and what an outlay of money to purchase this! Then, where there are embankments, you must deepen and widen these proportionably—an expensive process! Again, how are you to carry your rails past the bridges? Only, as appears to me (at least in the generality of cases) by building another archway, which, as it will have its base on the canal bank, and cannot necessarily be carried higher (if as high) as the key-stone of the water-arch, I should doubt would be mostly too low to admit the passage of an

engine and waggon. At any rate, the expense would be enormous, and I should think inevitable. On the whole, as you have offered no objection of a scientific kind to my simple suggestion, I cannot but think that we shall see this method of constructing rail-roads upon the beds of canals for the conveyance of *all sorts* of merchandise, very generally adopted, both to the benefit of the public and the proprietors.

I am, yours respectfully,

WM. D. R.

Chelsea, Dec. 3, 1829.

NEW AND EASY METHOD BY WHICH TO MEASURE THE HEIGHTS AND DISTANCES OF HILLS AND MOUNTAINS, &c.

Sir,—As the determination of the heights of hills and mountains, with any considerable degree of precision, has ever been regarded as rather a difficult application of the principles of mathematical science, as is evident from the conflicting results regarding the Peak of Teneriffe, and other mountains, as given to the world by many eminent philosophers- any method that has for its object the simplification of this process, together with increased precision of result, may not be deemed wholly uninteresting to your numerous and intelligent readers. Should you concur in this opinion, and think the following plan possessed of either of these requisites, you will much oblige, by its early insertion in your far-famed and useful miscellany,

Sir,

Your most obedient servant,

JOHN O'GROAT.

Duncan's Bay Head, Oct. 1, 1829.

The plan, or method referred to, is simply as follows:—On a fine, clear, sun-shiny day, observe when the sun's bearing approaches that of the hill whose height you wish to determine. With a surveying-chain, measuring-tape, &c., lay off a base-line in the usual manner, (the longer the better, provided the sum of the horizontal *angles* at the base be not less than 90°,) with as much precision as possible, and as nearly at right angles to the hill as the nature of the ground will permit. Then with a Hadley's sextant, or quadrant, well adjusted at each end of the base, measure the horizontal, or inclined angles, which the hill in question makes with the opposite end of the base-line respectively, and carefully note the results. Taking a mean of two, three, or more observations of each angle, will conduce to still greater accuracy; and is a mode of operation never to be neglected, where the circumstances of the observer will admit. With these angles and the base jointly, the distance of the hill is to be inferred in the ordinary trigonometrical manner; and its correctness will always be directly commensurate with that of the base and horizontal angles.

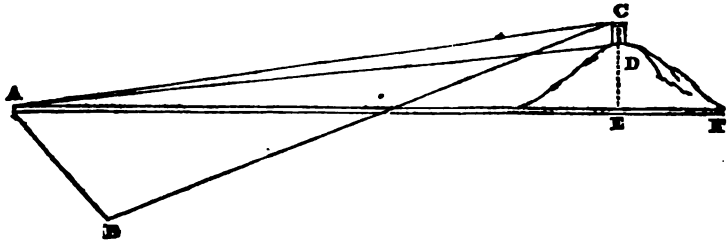
By this time we will suppose that the sun bears directly over the hill under consideration, or, which is the same thing, is on the vertical circle passing through its top. At that end of the base, or point, above which we wish to ascertain the height of the hill, with an artificial horizon of mercury, or of common spring water, well defended from the agitations caused by the wind, take the altitude of the sun's lower limb by reflection; half this angle will be the apparent altitude of that limb above the true horizon. Instantly bring the same limb of the sun directly in contact with the top of the hill, and note the angle; the difference between which and the former, or sun's altitude, will be the true angular altitude of the top of the hill above the place of observation. A mean of two or three observations of this angle, taken within as short a space of time as possible, is always to be preferred to any single observation.

Refraction is not taken into account, because of its uncertainty and variableness with regard to hills situated on the verge of the horizon, and because it is not supposed to affect the relative altitudes of the sun and hill, otherwise it might be easily allowed for. Should the hill lie to the northward of the observer, the only difference would be to make use of the *back*, instead of the *fore*, observations, the sun being on the opposite side of

the vertical circle, intersecting its top. The distance and altitude of the hill being thus obtained, the mode of ascertaining its perpendicular height must be obvious to the merest tyro in trigonometrical knowledge.

If the observer is so near its base, or the hill so lofty, that its image may be seen by reflection from the artificial horizon, then it is evident that its altitude may be taken without the intervention of the sun's altitude at all, and the whole process will thereby become considerably easier. The great, indeed the only advantage of this method over every other with which I am acquainted, is, that by it the angular altitude of a distant hill, or mountain, too low to be seen by reflection, may be obtained with great facility and correctness. For by means of the telescope and tangent-screw, the visible contact of the sun and hill may be made as perfect as that of the limbs of the sun and moon in a lunar observation, which, owing to the great perfection to which the sextant has now been brought, is truly wonderful, and next to absolute precision.

I shall now conclude with an example illustrative of this method: which example is the actual determination of the height of a small hill and tower in this neighbourhood, on the 25th of September last.



In the preceding diagram, let AB represent the base, AEF the sensible horizon of the observer, ED the perpendicular altitude of the hill, and CD that of a tower on its top. Also let the base, AB=30 Scotch chains, each 74 English feet, the inclined or horizontal angles ABC=99° 6′ and BAC=73° 8½′; likewise let the vertical angles CAD and DAE be 8′ 52½″ and 46′ 41½″ respectively; required the distance and height of the tower, and the perpendicular altitude of the hill above the level of the sea—height of the eye 88 feet?

1st. To find the distance AC, in the horizontal triangle ABC.

$$180° - 96° 6' + 73° 8\tfrac{1}{2}' = 7° 45\tfrac{1}{2}' = \text{ACB}:$$

then as S. 7° 45½′ : S. 99° 6′ :: ch. 30 : ch. 219·4 = 2·7425 Scotch miles; the distance required.

2nd. To find the height of the tower CD, in the vertical triangle ACD.

As radius : S. 8′ 52½″ :: ch. 219·4 : links 56·6 = 41·884 feet, height of the tower above its base.

3rd. To find the perpendicular height, or altitude of the hill, DE, in the vertical triangle ADE. By the like analogy it will be,

As radius : S. 46′ 41½″ :: ch. 219·4 : ch. 2·98 = 220·52 feet, height of the hill sought, above the eye of the observer.

4th, and lastly,

	Feet.
To height of the hill	220·52
Add that of the eye	88·0
And allowance for curvature of the globe, answering to distance	5·0
Altitude of the hill above the level of the sea	313·52 feet Q. E. D.

MINOR CORRESPONDENCE.

Sir,—Mr. Wynn's observations, quoted by his opponent, Mr. Harrison, vol. xii. p. 237, prove that his conception of the manner in which the teeth of wheels act upon each other *when properly formed*, is much more correct than Mr. H.'s: whose remarks on the subject are certainly not such as might have been expected from a man who pretends to treat the subject scientifically. The best mode of forming the teeth of wheels is by involutes of circles (by some, perhaps, considered a sort of epicycloids). Teeth formed in this manner on a wheel ten feet diameter, and working three inches deep, will only *slide* on each other one-sixtieth of an inch. Whether Mr. Harrison would introduce *rollers*, in the expectation of *lessening* this friction, is for himself to decide. In support of what I have asserted, I beg to refer your readers to Gregory's *Mechanics*, vol. i. art. 147; Robison's *Mechanical Philosophy*, art. Machinery; *Ency. Britt.* vol. ii. pp. 103, 106, vol. xx. p. 104, and Rees' *Cyclopædia*, art. Clock-movement.

Yours, respectfully,
S. Y. (a Young Engineer.)

Dec. 1, 1829.

Consumption of Smoke.—Sir, Your correspondent, "A Proprietor of a Foundery," wishes to know whether the plan I propose would cause an abatement of heat? I believe the contrary will be the effect; but if he will send me his address, I will communicate the plan to him.

Yours, respectfully, Z.

Manchester, Nov. 28, 1829.

Painting on Parchment.—Sir, Having observed in No. 329 of your Magazine the use of alum recommended in laying water-colours on parchment, I beg to say that I have used that as well as other methods on *prepared vellum* without the desired effect. A succession of light tints on parts previously passed over with a brush dipped in clean water, I found the most successful; but the tediousness of this process is an objection. I have observed also, during these operations, that some colours (especially gumboge) lie infinitely better than others (especially indigo and lake): so that to discover what one colour possesses different from another, might lead to the discovery of a remedy against the difficulty. I am told that prepared ox galls will answer, but have not yet had an opportunity of making the experiment. I am, &c. E. W. G.

Lathe Bands.—"The band I use to my lathe is a hempen one of three strands, cable laid, one-eighth of an inch in diameter. After I had properly spliced it to make it traverse smoothly over the pullies (my lathe being on the plan of Mr. Williamson's, described in the "Mechanics' Magazine," vol. i. p. 360), I soaked it well in unboiled linseed oil, and suffered it to dry. I have since wetted it several times with the oil, using it at the same time. It has been now in work more than twelve months, is perfectly smooth, has every appearance of catgut, and seems as strong as ever. One great advantage attending a lathe band thus prepared, is that, besides wearing well, it is nearly impervious to the damp of the atmosphere." HOMO.

MISCELLANEOUS.

Smoke-disperser of M. Millet.—This apparatus consists of a "kind of tub, pierced with a great number of holes, having the burs outwards. It has been taken into practice by many persons. In order to prove its efficacy, one of them was fixed on the top of the funnel-pipe of a stove, and a *very close*, smoky fire made below." All attempts to make the stove smoke proved ineffectual. "Whatever may be the cause, the apparatus offers a cheap and effectual remedy for smoky chimneys, when this fault in them is dependent upon the pressure exerted by winds upon the upper aperture of the flue."—*Bull. Soc. Enc.*

Potato Farina.—"I have been for some years in the habit of procuring potato farina by grinding potatos on a circular tin grater, fixed to a common lathe, with a tin shield over it to prevent the splashing; open in front, above three inches square, to admit the potato which is pressed forwards by hand on a small wooden trough placed opposite the hole. The operation is performed with very great facility and quickness; and the pulp is received in a trough, or pan, supported under the frame of the lathe."—*Extract from the Letter of An Amateur Mechanic.*

Cure for the Bite of Rattlesnakes.—It is stated in the *Colombian Telescope*, on the authority of a gentleman than whom "there is no man in the world upon whose veracity more reliance may be placed," that a decoction of the plant known among botanists by the name of the Asclepias Verticellaria, has been found in three different cases to cure effectually the bite of the rattlesnake. "A tea is made of the plant, root and top, and then given to the patient in broken doses."

INTERIM NOTICES.

We must decline inserting any communication on the subject of the Mechanics' Institution which does not meet us fairly on the merits of the case. Is the number of Mechanics belonging to it as inconsiderable as we have stated, or is it not? Has it been deserted by the great body of the Mechanics of London, or has it not? Is it over head and ears in debt, or is it not? As long as none of these matter-of-fact questions can be answered in the negative, all the laudatory writing, which such persons as *Fidelitas* or *A Member of the Committee* can bring to the aid of Dr. Birkbeck, will not vindicate the Doctor from the charge of perpetrating *a great delusion* on the public, in holding forth this ruined Institution, to be every thing that the warmest friends of popular instruction can desire.

A Real Friend to Dr. B. should have been taught discretion by the answer he received from *The Times* on Monday; and not have attempted to foist his *advertising puff* at second-hand upon us.

H. H. has overlooked the answer given to his request among the interim notices in No. 330.

We have received a communication from a correspondent at Exeter, containing all the information desired by *Homo*, and other correspondents, respecting the Camera Lucida, and shall endeavour to find room for it in a week or two.

The promised notice of Mr. Gurney's Steam Carriage, though deferred, is not forgotten: we think we may safely pledge ourselves that it shall appear long before either "N," or any one else, sees the carriage itself in actual use.

"W. S. Ignoramus" is requested to favour us with his address.

Communications received from Mr. Sims—Mr. Higgins—B.—Amator Scientiæ—Mr. Sly—Mr. Gibson—C. H.—Mr. Reilly.—S. P. W.

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M. SALMON, Printer, Fleet-street.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 333.] SATURDAY, DECEMBER 26, 1829. [Price 3d.

PILE-DRIVING MACHINERY.

Fig. 1.

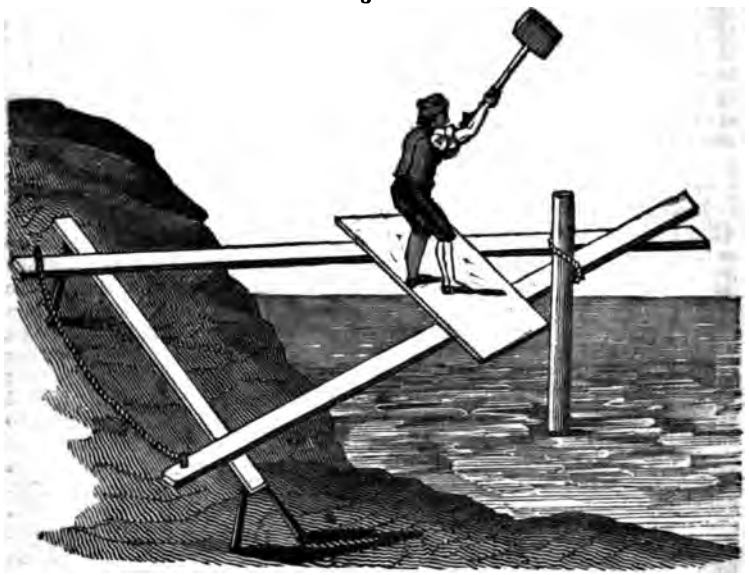


Fig. 3.

Fig. 2.

Fig. 2*.

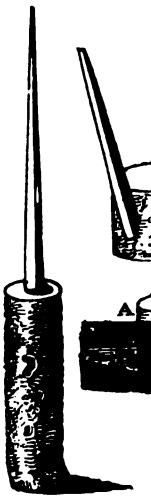
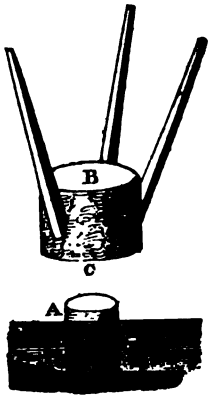


Fig. 3*.



A DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE THAMES. BY MR. C. DAVY, ARCHITECT.

No. 5.

Pile-Driving.

(Continued from p. 229.)

I have now arrived at that part of my subject which will treat more particularly of the machinery employed in the erection of bridges and other heavy works. The pile-engine, with its various modifications, is a subject of considerable interest. Your readers will probably recollect, that when the pile-driving question was agitated in your pages, a correspondent ventured to hope that as so much had been written about pile-driving, some one or other would give, through the medium of your pages, the various plans of machines for that purpose. The nature of these papers has fortuitously thrown upon me that task; and I shall from this cause perhaps occupy a greater space than I at first intended in describing this machinery.

The operation of pileing has been rarely dispensed with in bridges, quays, light-houses, locks, &c. On the Continent and in America many extensive tracts of land have been piled throughout; in some cases cities have been erected thereon—Amsterdam is an instance. The solidity gained by this mode of searching for the firm ground, time and experience have shown to be the most judicious and scientific. That ground or even rock apparently firm and secure is not at all times to be trusted, will appear by the following singular accidents, which no human foresight perhaps could have prevented.* Blondel instances the thick walls of the Church of Val de Grace, at Paris, which gave way on one side, though built upon a good bottom, because at some fathoms lower than their foundations there was afterwards discovered great cavities where had been formerly quarries of stone. Another instance, related by Gautier, occurred at one of the isles of Oleron or Re, where part of the walls of the fortification, though erected upon a rock, were overthrown owing to a cavity therein. There are few architects who are naturally averse to pileing; but, from various causes, many very extensive buildings are destitute of this mode of security. Inverts or inverted arches under openings and in walls, are amongst the other precautions against settlement. It is well known, however, that the latter will sometimes fail; and where neither the one nor the other has been used, those contortions will appear in buildings which are so remarkable in the streets of this metropolis and the suburbs. Sir Christopher Wren was amongst those who only partially availed themselves of the aid of pileing. Even in his greatest work (St. Paul's Cathedral) he has in preference trusted to the arch in many parts of the foundations. At the same time he observed, that should a settlement take place, it would be on the *south* side. This proved actually the case; and it is likely that had not the brick cone* been so securely tied in by massive iron chains at every 10 feet, its natural tendency to spread would have caused a more serious rupture. Whether this was an original idea of Wren's is difficult to determine. Michael Angelo had carried up the superstructure of St. Peter's, at Rome, with the greatest care and attention to its stability (by enlarging the slender piers previously erected by Bramante to a very great size), as high as the tambour on which the cupola was to be raised; and he left at his decease a model of the dome, for succeeding architects to conduct the same according to his design. The cupola was completed, and failed; and to prevent farther accident, a cincture of iron was subsequently inserted in the work. All this was *anterior* to the same plan being adopted in St. Paul's Cathedral. Acting upon the principle of "stronger than strong enough," piles should have been driven till the ram rebounded. Calculations might then have been made to ascertain the

* *The nature of the accidents would lead us to infer that all ground should be piled, an inference I conceive not far from the truth.*—C. D.

* A misunderstanding seems to prevail about the thickness of the cone. It is true that it is of 2 bricks' thickness, but these bricks are 18 *inches* in length! The present size in all our buildings is 9 inches.—Vide "Hughson's London."

amount of pressure that would be required to disturb them, and consequently the chances of failure would have been considerably lessened, which cannot possibly be the case upon bare and apparently firm ground.

M. Belidor, in his comprehensive work on hydraulic architecture, has given many varieties of the pile-engine. Most of these I shall give, with descriptions, as being highly important to the elucidation of this subject. The operation of pile-driving is exceedingly simple; and it is surprising that so many modifications should have appeared previously to that compact arrangement now so generally employed. The most complicated machine of this description was invented by M. Vanloue: a full description of which, with drawings, will be given in treating of Blackfriars and Westminster Bridges.

Piles are driven, in perpendicular, oblique, and horizontal directions, according to the nature of the work; but should a pile intended to be driven into the ground perpendicularly by any means be thrown out of that direction, it should at once be withdrawn. At Westminster Bridge a bent pile occasioned "the rupture of two arches."* The most simple method of pile-driving is exhibited in fig. 1:—"A slight scaffold is formed, and the extremity being made fast by ropes to the pile, the labourer with a heavy mallet drives the pile into the ground, his own weight at the same time contributing to the force employed. Fig. 2, is a heavy mass made with the thick end of a tree, encompassed with iron, and provided with handles for 5 or 6 men to work with; its weight is about 2 cwt. If with this apparatus we would wish to strike with greater precision, a hole is made in the middle of the pile, and in that a rod of iron is placed. Fig. 2*, the weight, is then allowed to slide on the rod, thus always striking the pile in the same place. The same rod of iron serves for all the piles. Fig. 3*, represents a mass of the greatest use, it is made in the form of a stool with three legs; a form which has an advantage that the others have not. In commencing to fix a pile, the summit of which they cannot reach with the ordinary mass, they use this from above, and when it is driven to a certain depth it is reversed. The power of one or two men is applied at each leg according to its weight. Before we proceed to describe the general construction of pile-machinery, it is proper to mention that it is the custom in these works to use the term *fiché*,* as referring to that part of the pile which is to remain in the earth: for example, when they would drive the pile to the depth of 10 feet, they say that it is to have 10 feet of *fiché*; and when it is to be placed in the situation to receive the blow of the ram, the direction for the workman is expressed in saying, 'Put the pile *en fiché*.'"

(To be continued.)

* *Belidor.*

* Fiché, thrust in, stuck, pitched, drove.—BOYER.

MEASUREMENT OF HEIGHTS.

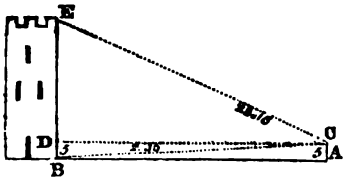
Sir,—A few evenings since I was dipping into vol. v. of your valuable miscellany, and in p. 173, saw a trigonometrical problem solved by T. H. Bell, who seems to think that the method of doing it originated with himself. So it might have done as it did with myself, above a dozen years ago, when I wrought the same problem by making the height of the instrument one side of the triangle, as he has done; and as I had never seen it before I, (like him) thought I was the first person it occurred to. Since then, however, in perusing Adams' "Geometrical and Graphical Essays," published by Jones in the year 1797, I saw there the same problem wrought in the same manner as T. H. Bell's. So that you see, Sir, this is a remarkable instance of the same thing originating with three different persons (which has been a source of much litigation in the patent world). But I must now beg leave to state, that although the same idea struck Mr. Adams, T. H. Bell, and myself, yet my method of *calculating* the problem is very different from that made use of by them, as I do it by the assistance of a set of new

trigonometrical tables, calculated by myself, whereby the operation is shorter than by the logarithmetic tables: the latter being necessary to be referred to six times to complete the problem by Messrs. Adams' and T. H. Bell's way, while by my tables, as will be hereafter seen, I refer only twice for the same purpose. They are constructed upon the principle of *similar triangles*, and consist of three columns, thus—

Deg. Min.	Hypothenuse.	Longest Leg.
23 15	2·534	2·329

which means that at that angle (the shortest leg or perpendicular being 1) the hypothenuse is 2·534, and the longest leg or base 2·329.

Now, seeing a tower at a distance, and on the same plane with myself,



I plant my instrument, which we will say is 5 feet high, at A, and after having very carefully adjusted it (a circumstance to be strictly attended to), I take the angle of depression BCD, and find it to be 2 degrees, 30 minutes. I then refer to the tables at that angle, and see against it in the column of longest legs 22·914; therefore I say 1°: 5† :: 22†·914: 114·57 = CD. Then to find the height of the tower I take the angle of elevation DCE, which is 23 degrees, 15 minutes, and turning to it in the tables see against it in the column of longest legs 2·329; then I say,

CD DE
2·329 : 114·57 :: 1 : 49·19,

the height of the tower, minus 5 feet the height of the instrument. So that these operations are in this instance merely multiplying by 5 to find the distance, and dividing by 2·329 to ascertain the height. The hypothenuse of the triangle is found by working from the hypothenusal column instead of that of longest legs.

I have written a small treatise explanatory of the tables, and with them forming a concise method of working all the several cases in right and obtuse-angled plain trigonometry, with its application to longimetry and altimetry; which treatise it was my intention to have published, but time of life and other avocations make me now not desirous of it. However, if any person would like to undertake it, he may see the manuscript by calling on me.

I am, Sir,
(With my ardent wishes for the continued success of your excellent Magazine,)
Your obedient servant,
T. TIMES.

Mitre Chambers, Fenchurch-street, Nov. 19, 1829.

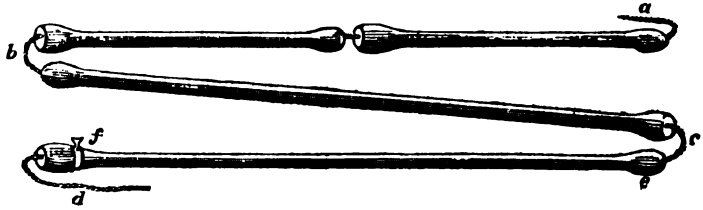
* *The shortest leg in the tabular triangle.*
† *The shortest leg in this triangle.*
‡ *The longest leg in the tabular triangle.*

CHIMNEY-SWEEPING APPARATUS.

Sir, — As mechanical chimney-sweeping is not universally practised, we are naturally led to suppose that there is something more than public prejudice in the way, and that the apparatus employed still needs improvement. The cause of humanity is so deeply concerned in endeavours to emancipate some hundreds of children from the degrading drudgery to which they are subjected in their capacity as climbing-boys—and the amelioration of their condition is an object so desirable—that I think no apology need be made for adding to the general stock of inventions intended for that benevolent purpose.

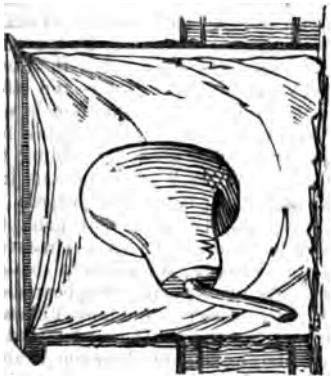
The apparatus I am now going to describe, whatever merit it possesses in other respects, is wanting in that of extensive application. It appeared so likely to answer in the most difficult cases, judging from the model, that I had a large one made, between 30 and 40 pieces long, and was at some pains to render it serviceable for straight or bent chimneys. In practice, however, it was found that when the machine entered an irregular flue, a certain degree of mechanical power was lost, and the woods soon jammed in

the crooked part. The woods forming the pole were bored in the usual manner for putting a cord through them, and one end of each being rounded and the other hollowed, they fitted closely, making a continuity of cup and ball joints. In the following figure



are shown four pieces, joined by the cord *a*, *b*, *c*, *d*; the end *e* fits exactly in the cup *c*, and so of the rest. On the cup end of every fifth piece there was an iron ring *d*, *f*, with a thumb-screw *f*, to pinch the cord after drawing it as tight as possible.

The cloth or curtain* which was used with this machine is an excellent contrivance for keeping the soot within the fire-place. It is made by cutting a large circular hole in the centre of the cloth intended for the curtain; this is then filled up by seaming to the edge the mouth of a bag, in the bottom of which there is an aperture opening into a sleeve one or two feet long, so that it very much resembles a large funnel protruding from the cloth, when secured to the fire-place with spikes, as seen below.



In using the cloth the top-end of the pole is put through the sleeve and bag from the outside, the head of the brush is then attached and laid on the grate, and the cloth fastened to the mantle-piece. When the hand grasps the pole by taking hold of the cloth sleeve, the aperture is so perfectly closed as to prevent the ingress of soot; and when it is necessary to bring the hands and the machine in such a position as that both shall be directly over the grate, all that is necessary to be done is to push the projecting bag inwards, when all that can be wanted will be obtained without disturbing the curtain or making the least opening for the escape of sooty particles.

I am, Sir,
Yours respectfully,
Stepney, Nov. 1829. HENRY D.

* See the "Repertory of Patent Inventions, &c." *No. 40, April, 1829, p. 237.*

THE BRITISH ALMANAC AND COMPANION TO THE ALMANAC FOR 1830.—MR. LUBBOCK'S DEALINGS WITH THE TIDES.

(Third and concluding Notice.)

"Hast any philosophy in thee, shepherd?"
SHAKSPEARE.

II. *Remarks on the disquisition on the tides in the "Companion to the Almanac."*

Mr. Lubbock commences his disquisition with a history of what has been already done in this region of inquiry, of which we need only say, that it is quite as full and accurate as might be expected from a gentleman whose reading has left him with those notions on the subject, which we presented to the admiration of our readers in our last and preceding Numbers. He then indulges us with about five pages of mathematical verbiage—we had almost called it investigation—which we will venture to say, will make more than the mere "groundlings" stare. We can but re-

commend its perusal to those who have *nothing to learn* respecting the theory of the tides, or to such as desirous of pursuing the research, would like a Will o' the wisp for their guide.

We have already noticed the levity with which it pleaseth this prince of investigators to speak of the renowned Laplace. He commences his present paper with an allusion to a something in the "Mecanique Celeste," which he does not call a blunder, but which yet he assures us "is not a misprint." Laplace's "notation," he says, "is at variance with that used by himself." Be it so; perhaps it is so. But, let us ask, is it at variance with truth? Or does it vitiate his results? As we intend keeping Christmas at Gilead Hall along with Dr. Birkbeck and some other sworn enemies of quackery and humbug, and write this while on our way thither, we regret we cannot refer at present to the "Mecanique Celeste" itself; for we have no doubt that even we should find the matter of difficulty lies very near the surface. This nibbling at the most accomplished analyst the world has yet produced—except perhaps Lagrange—is very paltry. It never *could* have passed the scrutiny of a *Superintending* Committee who did their duty, without being suppressed.

But though Mr. Lubbock does not seriously question the substantial efficiency of Laplace's manner of notation, he makes bold to *depart from it entirely;* yet, as if only half assured of treading on safe ground, in less than two pages he makes a *second* slip in his notation, and in less than half a page more a *third*. He compares or rather seems to compare his results with those of Laplace, Bernoulli, and Euler; yet with all this changing, and shifting, and comparing, he cannot bring any one of his modifications to accord with the results of either of those distinguished philosophers. Really there was no more reason for thus altering the notation, than there would have been for changing his wig every five minutes during the process; and if it were not that Mr. Lubbock is an F. R. S. and all that, we should suspect, as a friend suggests, that he extracted his formulæ from some old college portfolio, and was afraid of modifying the notation to agree with Laplace's, lest he should fall into some such blunder as the musical amateur did who on transposing a tune in the major mode from the key of G *to that of F, put E sharp* instead of *B flat*.

We do not profess to be very deep in such matters, otherwise we should seriously call in question the means by which our notable investigator simplifies his results. Thus, at the bottom of p. 53, he simplifies an expression for finding the time of high-water by saying, "*if we suppose the luminaries to move in the equator*, we have," &c. Very true, Mr. Lubbock, you may "call spirits from the vasty deep." But will they come at your bidding? *Will* the luminaries move in the equator, or *be there* simultaneously, as you suppose? Of the three orders of phenomena in the tides, occurring respectively, twice a day, twice a month, and twice a year, the last which exhibits an augmentation of tidal flow near the equinoxes has its maximum when the moon is new and in her perigee at an 'equinox. Mr. Lubbock must not approximate perpetually to this state of things by *an hypothesis*, nor must he, however much it may serve to simplify the theorem, assume it as a fact that the sun and moon are always in the equator. With regard to a mean state of things the hypothesis might, as we hinted last week, be adopted safely in latitudes at or near 45°, as was done by Laplace. But in other latitudes the height of the tide and (though in a less degree) the time of high-water varies so with the declination, that it cannot be supposed *nothing* without involving great inaccuracy.

It would be easy to offer other very solid objections to Mr. Lubbock's theoretic researches; but as he applies them scarcely at all to his subsequent practical inquiries, and *not at all* to the table at p. 5, "British Almanac," which we should *à priori* have thought it would have been his main object to verity (and not to *nullify*, as he does in fact), we proceed to examine his practical deductions.

Mr. Lubbock's object has here been to form and classify the times of high-water at the London Docks when the moon was one day old, two days old, &c., and then to deduce from them the times of high-water corresponding to every *hour* of the moon's southing. Now this method is from the beginning to the end objectionable. Let us attend, for example, to the results which he tabulates at pp. 57, 58. He there endeavours to infer a mean from the observations of twenty-four years, which he says (p. 58) "includes a complete revolution of the moon's nodes." To be sure it does, and a great deal more than a complete revolution. But had Mr. Lubbock computed his means *by his own* method for even the mere period of the

revolution of the nodes, he would have found them to differ sometimes three or four minutes, sometimes six or seven, from those he has presented. Besides, how fallacious must be a system of means deduced from simply taking the difference between the times of the moon's southing and of the succeeding high-water! The differences, for example, on the same day of the moon's age in 1802, 1804, and 1806, were 55, 45, and 35 minutes! A truly scientific observer knowing that these discrepancies are affected by the concurrence or non-concurrence of several causes, as varying lunar and *solar* distances,* &c., would aim at their *separation* by some of the admirable methods which his art supplies. The sidereal revolution of the moon's perigee, the varying inclination of the lunar orbit, the varying obliquity of the ecliptic—all of which are periodical variations, each having a different period from the revolution of the moon's nodes—all affect the differences in question: hence Mr. Lubbock's results become vitiated throughout, and no saving clause about Bernoulli's "beautiful theorem" (p. 64) will avail Mr. Lubbock or his Superintending Colleagues; for by his own showing, and indeed confession, (p. 58) he has neglected just *one-half* the requisite observations.

Whether all this neglect has arisen from the influence of that power which Hudibras characterises as reigning over certain brains "in high spring-tides at midnight," or whatever be the cause—here is an acknowledged fact, which renders what was blundering before supremely ludicrous. There is not a pilot from the Downs to the Humber who does not know, that at the Nore and in the River the inferior or secondary tide is greater than the superior, and flows in a different time when the moon has north declination, and *vice versa*. Now can the anomalies thus occasioned, and others of which we have not room to speak, be fairly or even feasibly reduced to a mean when half the observations are neglected? Let Mr. Lubbock, who through the kindness of that truly public-spirited individual, Mr. Isaac Solly, (Chairman of the London Dock Company) has so much information at his command, turn to the plates which illustrate the tides for one month only in Mr. Palmer's "Report on a New Entrance to the London Docks," and he will have such evidence of the difference of two consecutive tides as should we think raise some doubts even in *his* mind of the correctness of his own process.

But that these things render so excessively palpable the system of blundering which pervades the whole of Mr. Lubbock's inquiry, we know not that we should have touched upon them; for the acknowledged facts to which we briefly adverted in our first notice (No. 331), fully prove that all this gentleman's learned labour is, independently of other considerations, *totally useless*, because founded on observations grossly inaccurate. It is admitted that the tides are not observed at the London Docks within *ten* minutes, and that the register may be wrong by *five* minutes (p. 61). "At St. Katharine's Docks the observations are made with *about* equal precision." And at the East India Docks the matter is no better (p. 62). Mr. Lubbock seems to place great faith in a pretty little apparatus "with a vernier," (p. 62)—but he may rest assured that even that will fail him, for a stray wave or two, three inches higher than the rest, thrown across the Thames by a gust of wind, would inevitably spoil all. We have a plan in our minds which we are persuaded would be infallible—and it might please Mr. Lubbock because it depends on a curve and a computation—but we shall take example by the calculators of tide-tables, and for the present at least keep it a secret.

But we fancy we hear some dogged admirer of the "Diffusion Society" thus exclaiming, 'Not so fast, Mr. Editor; you think you have made sweeping work of Mr. Lubbock and his computations: but you have overlooked the sovereign test by which this investigator checks and restrains all those irregularities to which you have alluded, 'the clock whence the time is taken,' (p. 62)—the clock of Rotherhithe Church!!

Shades of Newton, Bernoulli, Euler, and Laplace, descend and do homage to the superior sagacity of J. W. Lubbock, Esq. F. R. and L. S.! The time as shown every day for 24 years by Rotherhithe Church clock—a clock which the observer has no other control over, than what he derives from gazing at it across the Thames—a clock which may have been as often going as not going, as often going wrong, as going right—made an element in computing the tide-columns of "The British Almanac!!" Woe unto those luckless mortals, the calculators of high-water for "White's

* The sun's distance changes in the course of half a year by its *thirtieth* part.

Ephemeris" and "Epp's Tables," unless they can prove that they have uniformly had recourse to the same infallible criterion!!! In our summer excursions on the Thames some six or seven years ago, we used to notice that this said clock was almost always wrong; sometimes from five to ten minutes too slow, at others as much too fast. Certainly, the limits of its errors cannot be taken at less than from five to twenty minutes; and if we add the ten and five minutes' uncertainty in the observations, it follows that the results on which Mr. Lubbock prides himself so much may have been *half an hour in error*. But what of this? We are aware Mr. Lubbock may reply, "that the period of irregularities of the clock is not the same as that of the observations," and that the whole only furnishes (p. 64) "*a very striking illustration* of that beautiful theorem in the doctrine of probabilities, showing that inequalities whose period is not the same as that according to which observations are *ordained*, disappear, if a sufficient number be examined!" That is, in other words, a very striking illustration of this newly-discovered truth, that when you do commit errors, you have only to commit enough of them to make all right!!!

Do we then mean to discredit what Mr. Lubbock advances as to that "coincidence between theory and observation which is truly wonderful?" By no means. We have no inclination to question this gentleman's veracity. We doubt not that he is fully persuaded of the truth of what he says, but we are as firmly persuaded that he has mistaken error for truth. In matters which lie so deep, and which are made more muddy by his manner of treating them, it would not become us—who acknowledge ourselves to be but novices in what Laplace, if we recollect rightly, calls the "most thorny investigation in all practical astronomy"—to speak *positively*. But we are tempted to conjecture that Mr. Lubbock has merely *gone to and fro* in this affair. From "the mean of all the observations" he finds (p. 59) that the logarithm of $\frac{m'p^3}{m'p'^3} =$ 9·52452; and then (p. 64) taking the logarithmic value of the same quantity, but reversing the process, he finds that the means agree nearly with those from which he set out. This is just as if an ignorant land-measurer were to trundle a surveying-wheel before him from *Tottenham Cross* to the John Gilpin at *Edmonton*, and to measure the distance back again to Tottenham Cross with a chain, and then exclaim, "Well, this *is* amazing! The distance measured both ways and by both methods is the same precisely within four or five yards, and agrees very nearly with the distances as laid down in Cary's 'Road-Book!' What 'A TRULY WONDERFUL COINCIDENCE!!!'"

But it is now high time we should close this amusing though, on the whole, really painful inquiry. We have so true an esteem for many of the individuals who have joined themselves to the "Knowledge Diffusion Society,"—not a few of whom we have the honour to rank among the most able contributors to our own pages—that it is with no pleasure we censure any thing which carries their names in its front. There has, in truth, been a mighty struggle within us between inclination and duty for mastery on the occasion; and never did we feel more keenly the correctness of the couplet,

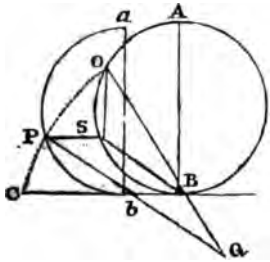
> "To laugh were want of dignity and grace,
> But to be grave, exceeds all power of face."

Trusting that the Superintending Committee of the Society will act upon the maxim which they quote in their Almanac, p. 26, and "love those who advise, not those who praise them," we conclude with earnestly recommending to them either to renounce the character of *Superintendents* altogether, or to perform the duty of superintendence honestly and in good earnest. There are individuals on this Committee who *could* have brought to the task of computing the tides all the peculiar learning and all the practical experience necessary for executing the task in a manner that would have left us no room for animadversion—Captain Beaufort, for example, the eminent hydrographer to the Admiralty, or Dr. Inman, the Professor of the Naval College at Portsmouth; and we do say, though more in sorrow than in anger, that it is nothing to the honour of these gentlemen to lend their names to give a corporate sanction to errors of which they are themselves incapable, and which if committed by them individually, would bring them, as professional men, into everlasting disgrace. For what purpose, may we ask, are persons of various pursuits and attainments placed on the Committee? It must be either that each may bring the aid of those peculiar qualifications which give weight to his name into active operation when wanted, or that the public may be deceived into a belief that such is the case. The Members of the Committee may take their choice.

In the one case, we have a gross neglect of duty to complain of; in the other, a willing participation in a great scheme of public delusion. One more such "British Almanac"—one more such article, by way of companion, on the tides—and the reputation, if not the existence of the Society will be irrevocably gone.

METHOD OF FINDING THE RADIUS OF CURVATURE OF A CYCLOID.

Sir,—I send you, in answer to Mr. Jopling's communication, (vol. xi. p. 392.) another method of finding the radius of curvature of a cycloid.



Let CPO be a cycloid; ASB, aPb, any two positions of the generator; Bb the corresponding points of contact of the generator and base; and O, P, the points of description. Join OB, Pb, and produce them indefinitely towards Q, and from B parallel to Pb draw BS: join PS. Now the angles PbC, SBb, are measured by half the arcs Pb, SB: but because SB, Pb, are parallel, and $\angle PbC = \angle SBb$ ∴ the arcs Pb, SB, are equal; and since the two circles are equal, the chords are also equal ∴ $PS = Bb$: because the angles BbQ, bBQ, are less than two right angles, by the $\angle SBO$. ∴ Pb and OB produced will meet on the side towards Q (Euc. 12 Ax.); and let Q be their intersection. Now in the triangles BSO, BbQ, the angles at B and Q are equal; also $\angle BbQ (= \angle bBS) = \angle BOS$ (E. 3. 32.): therefore the triangles are similar, and $BO : SO = bQ : Bb$; but Bb (by the mode of generation) = the arc SO. ∴ alternately $BO : bQ$ = chord SO : : arc SO. Let PO be diminished without limit, and we have ultimately $bQ = BQ$, and the chord SO = the arc SO. ∴ $BO : BQ$, in the ratio of equality, or $QO = 2\,OB$. Hence, as before, the radius at the cusp = 0, or is infinitely small.

Although by the methods before given the same result is obtained, yet in order to satisfy, as far as I can, the inquiries of your able correspondent, Mr. J., as he had originally limited his doubts to the cycloid, I deemed it better to give a solution for that particular case, which would admit of the different numerical values of BQ for any intersections being known; and such is the above, by the help of the common tables of sines and circular arcs: for $BO : BS\ (Pb) = bQ : : BQ$. Hence as bQ is already known, and BO, Pb given, BQ may be determined.

From his communication, Mr. J. seems inclined to think that the radius of curvature at the cusp is infinitely great, rather than of any finite dimensions: he says, "the nearer the ellipse approaches the right line, the less the radii of curvature at the ends become, &c.;" and from thence infers, or at least adduces it as a confirmation of his opinion, that such radii at the cusp of cycloidal figures will be infinitely great. Now, in order that this argument may have its due weight, it should, I think, have been shown that the cycloid becomes a straight line when the radii at the ends vanish, which certainly is not the case.

If what is mentioned in the second paragraph of his letter had held good when extended to the case of nodated lines, it would have been a considerable argument in his favour; but that, I submit, is not the fact. Let the whole series of the cycloidal curves be drawn, then the nodated lines will be entirely *exterior* to the cuspidated, and, I should imagine, have a larger radius of curvature; but, at all events, if the radius at the cusp be infinitely great, that part of the node next to it cannot differ much from it, if we assume the two curves very near each other. A nodated line would therefore present the following variation of curvature: at the extremity of the node, almost infinitely small; at that part of the node which abuts laterally on, or nearly parallel with, the cusp, almost infinitely great; and at the vertex, finite. But as there evidently is an uniform and extremely graceful

variation of curvature in the nodated lines (some of which I think are superior in beauty to the cuspidated), which gradually decrease from the vertex to the node, I cannot for an instant (putting all demonstrations quite out of the question) think such can be the fact.

Again, if a cycloid be continued at the cusp by a straight line which is a tangent to the cusp, these two together should form a *fair line* on Mr. J.'s supposition, that the radii there are infinitely great. To me it appears that there would be something of an elbow; but of this that gentleman may easily satisfy himself. It would be interesting to me to know whether, if the inflected curves were united, similarly, to a straight line at the point of contrary flexure, it would have the appearance of being (as in truth it is) a fair line.

I am, Sir, yours, &c.

Nov. 2, 1829. R. C. Jun.

P. S.—I will take this opportunity of correcting an error of my own, at p. 30 of this volume. I have there stated that the evolute of the parabola is the common parabola, whereas it is the semicubical parabola, of which the radius of curvature at the cusp is infinitely small or nothing: of course the difficulty there mentioned no longer exists.

FARTHER EXPERIMENTS WITH "THE NOVELTY" STEAM-CARRIAGE.

Extract from a Letter from a Correspondent, dated Liverpool, Dec. 17, 1829.

"The anxiety universally entertained by the people here to see their favourite, 'The Novelty,' again at work, has been at length partially gratified.—Having undergone a thorough repair at Messrs. Fawcett and Co.'s factory, and been privately proved there in various ways, she made her re-appearance this morning on the Railway under the charge of Mr. Ericsson, and has been going *the whole day* with the greatest success: no accident or interruption of any kind (as far as regards the engine) occurred. She travelled sometimes with—sometimes without passengers, and at various speeds, generally from 25 to 32 miles per hour. In several turns her rate *of going* averaged full 40 miles per hour! The bearings most liable to be effected by this rapid speed—namely, the crank-couplings, the eccentrics, and the axle-tree brasses—*were not once oiled*, from the time the carriage began working till the conclusion of the day's operations. Nothing can be conceived more beautifully smooth than the entire action of this carriage; all its parts worked in admirable harmony with each other. The steam appeared to be got up and kept up at the requisite pressure, with the greatest ease, and at a wonderfully small expense of fuel. The spectators, who were at one time very numerous, were much delighted, and repeatedly testified their admiration by loud cheers. But that the Railway shares have already reached so high a premium, (about 80 per cent!) as scarcely to admit of any farther advance, I should not be surprised to see them take another start to-morrow. '*The Rocket*' has been also doing wonders in the way of speed; but the superior compactness, steadiness, and elegance of 'The Novelty,' combined with even the same speed as 'The Rocket,' would be sure to procure for it a decided preference. In order to prove *the power* as well *as speed* of the engine, a number of loaded waggons were attached to it; but by this time it was becoming dark, and the distance performed was not sufficient to furnish any satisfactory result. The experiments will be probably resumed to-morrow, or in a day or two after, when I shall again write you all about them."

Extract from another Letter from the same Correspondent, dated Liverpool, Dec. 21.

"I am just returned from Rainhill, and have but time, before the departure of the post, to acquaint you briefly with the results of another long day's experiments with '*The Novelty.*' It drew for several hours a gross weight of *thirty-five tons*, that is at least ten times its own weight, at the rate of *twelve miles per hour!!!* Can it now be doubted that this is as an efficient engine for weight as for speed? The superiority of the blast principle may be now considered as established beyond all doubt."

IMPORTANT EXPERIMENTS ON THE FRICTION OF WHEEL-CARRIAGES.

A number of experiments were made lately on the Liverpool and Manchester Railway, under the directions of Mr. Hartley and Mr. Rastrick, engineers, with a view of determining, 1st, what are the comparative merits of various patent wheels and axles for railway waggons; and, 2nd, what is the actual degree of friction of each; or, in other words, what proportion the force requisite to move or propel such waggons upon a railway bears to their load.

As the report of the engineers has not been yet made public, we cannot inform our readers which of the different patent wheels has been found to answer best, but we learn with great satisfaction that the following results have been deduced from the experiments:—

1. That a reduction of the proportion of the bearing of the axles of railway-waggons to the circumference of the wheels, causes a proportionate reduction in the friction.

2. That with loaded waggons, the bearing part of the axles of which is only 1½ inch diameter, the diameter of the wheels being 3 feet or thereabouts, the friction is less than 6lbs. to the ton, that is, only 1 in 400.

3. That though friction-rollers at the axles of waggons are in some respects advantageous, the great modern improvement consists in reducing the diameter of the axles.

As the waggons used on this occasion were the same which were employed at the Railway Competition, in October last, it follows that the power of the competing engines was then underrated *one-half*, inasmuch as the friction at the time was computed at 12lbs. to the ton, or rather less than 1 in 200. But the most important deduction we are disposed to draw from these experiments is, that steam-carriages can never be expected to run successfully *except on rail-roads*. The resistance to the rubbing surface of the wheels on a railway is as nothing, and the friction only 1 in 400: and admitting the power of an engine to carry a load up an ascent of 1 in 30 to be only one-eighth part of its power on a level, *still the force* of the engine working on a railway must be ever pre-eminently superior to one working on our common roads, on the very best of which the resistance and friction together are as much as 1 in 20 in summer-time, and 1 in 10, 1 in 12, and never less than 1 in 15, during the winter half of the year. For heavy goods, at a slow rate of travelling, and on comparatively level roads, steam-drags may be used as substitutes for waggons and vans; but the rapid pace now required by modern impatience can only be expected to be attained along railways, which, to obviate danger, should be as completely isolated by fencing and bridging as canals now are.

FORMATION OF ORES.

Vauquelin informs, that, on examining the fragment of a statue which had been long buried, he found the exterior of red copper, and the interior of copper in its metallic state. It is evident that these changes in the copper, in the specimens just enumerated, had been produced by the action of the atmosphere and of percolating water. It is equally well known that similar changes have been produced on copper when fused under particular circumstances. Examples of this kind were met with in masses of copper inclosed in the lava which, in the year 1794, flowed over a considerable space of the district of Torre del Greco. Common copper coins were converted into red copper, and in some specimens the surface was crystallized, while the interior had a radiated structure. In some of the specimens of brass candlesticks from Torre del Greco, preserved in the museum of the University of Edinburgh, the zinc has separated from the copper. On some of them there are small brownish crystals of translucent blende, numerous octahedrons of red copper, and very beautiful copper-red cubes of pure copper. In other specimens from Vesuvius, mentioned by authors, the zinc and copper have separated, and each appears crystallized in their due forms. Masses of iron, partly crystallized in octahedrons, and also in the state of iron-glance and sparry iron, have been found in the lava of Vesuvius. Silver in beautiful octahedrons, lead in the state of litharge, and galena, or lead-glance, in the cubo-octahedral form, have also been collected from the lava of Torre del Greco.—*Schweigger's Journal*.

HARRISON'S ESCAPEMENTS.

Sir,—I now proceed, agreeably to the pledge in my last communication, to show, in opposition to the assertion of Mr. Wynn, that my escapements have both merit and novelty to recommend them. Amongst all escapements for clocks which have hitherto been published, will Mr. Wynn have the goodness to point out any detached ones that *roll in and out*, as those we commonly use do—or any that maintain the motion of the pendulum by an impulse given only every *second* swing, as my other escapement, which I esteem the most complete, does; and which with the detached pallet-wheel, (the construction of which detachment is such as perhaps has not occurred to any person besides myself,) I consider to be the *ne plus ultra* of escapements for pendulum-clocks; for I do not see any possibility of either any greater simplification or any farther improvement being admitted. Besides completely cutting off every irregularity in the impulse given to the pendulum, this escapement is also susceptible of being adjusted to compensate the different densities of the medium, so that the isochronism of the pendulum may not be affected by any variation therein; I may therefore perhaps be permitted to doubt whether there really be any escapement equal to it.

With respect to Boston clock escapement, I must give Mr. Wynn credit for the whole of his statement respecting it, as I know well that such pallets must needs act just as he has described; and yet I could give him two sufficient reasons why that clock would really keep a better rate with common recoiling-pallets than with those pallets.

Having prevailed on the gentleman whom I mentioned in a former paper as having an excellent transit instrument and a regulator with a compensation-pendulum, to take the trouble of observing the rate of the new clock made by my son for Christ Church, Hull—I have the pleasure of giving Mr. Wynn the opportunity of comparing it with the "unequalled accuracy of rate" of Boston clock. The time-keeper by which the clock was compared was 26″ slow of true time, and the clock was forward of the time-keeper as in the following register, in which also the times at which sidereal observations were obtained, are distinguished by the abbreviation *obs.* placed against those particular days:—

			min.	sec.		Daily variation in the rate.
March	12	obs.	1	5	.	0
	13	. .	1	4	.	1
	14	. .	1	2	.	1
	15	. .	1	2	.	0
	16	obs.	1	1	.	0
	17	. .	1	0	.	1
	18	. .	1	0	.	1
	19	. .	0	58	.	0
	20	. .	0	57	.	0
	21	obs.	0	56	.	1
	22	. .	0	54	.	1
	23	. .	0	52	.	1
	24	obs.	0	52	.	2
	25	. .	0	53	.	0
	26	. .	0	52	.	0
	27	. .	0	51	.	0
	28	. .	0	50	.	0
	29	. .	0	49	.	0
	30	obs.	0	48	.	0
	31	. .	0	47	.	1
April	1	. .	0	45	.	1
	2	. .	0	45	.	0
	3	. .	0	44	.	0
	4	. .	0	43	.	1
	5	. .	0	41	.	0
	6	. .	0	40	.	1
	7	obs.	0	40	.	0
	8	. .	0	39	.	1
	9	. .	0	37	.	0
	10	. .	0	36	.	1
	11	obs.	0	36	.	0
	12	. .	0	35	.	0
	13	. .	0	34	.	0
	14	. .	0	33	.	0
	15	. .	0	32	.	1
	16	. .	0	32	.	0
	17	obs.	0	31	.	0
	18	obs.	0	30	.	1
	19	. .	0	30	.	0
	20	. .	0	29	.	2
	21	. .	0	26	.	0
	22	obs.	0	25	.	0
	23	. .	0	24	.	0
	24	. .	0	23	.	1
	25	obs.	0	21	.	0

From this register it appears that the rate of the clock is 1 second per day slow, it having lost just 44″ in 44

days; and during this period the greatest deviation in its daily rate has been only 2 seconds. It is to be observed that this is a regular daily register, very different from that Mr. Wynn has given of Boston clock in No. 189, p. 214; consisting of a period of 18 days, during which, according to his method, it did not vary quite 1½″ per day. It seems the time was found by observations on the days he mentions; and to get the daily variation, that found by these observations seems to have been divided amongst the number of days that had intervened: so that although it might have varied considerably in the interim, such variation could not appear, provided it had gained as much at one time as it had lost at another. But notwithstanding the vagueness of this method, we are constrained to have recourse to it in order to compare the rates of the two clocks, because the same method must needs be taken for the one that has been adopted for the other. The days of observation were—

	Clock fast. min. sec.	Intervals.	Time lost	Lost per day.	Variation in the rate.
March 12	1 5	4 days	4″	1	0
16	1 1	5	5″	1	0
21	0 56	3	4″	1¼	¼″+
24	0 52	6	4″	¾	¼″−
30	0 48	8	8″	1	0
April 7	0 40	4	4″	1	0
11	0 36	6	5″	¾	¼″−
17	0 31	1	1″	1	0
18	0 30	5	5″	1¼	¼″+
22	0 25	4	4″	1¼	¼″+
25	0 21	—	—		
		44 days	44″		

Thus, according to Mr. Wynn's indefinite method of keeping a register, the greatest variation of this clock has been only ¼″+ and ¼″− = ½″ during 44 days; which (though it is only one-sixth part of its real variation) is not half as much as Boston clock varied in 18 days. And were we to take the time from March 30 to April 18, which includes 19 days, the variation during that time is only ¼″, which is not quite one-eighth part of the variation of Boston clock during 18 days. But this is not all. Boston clock has no external dials, nor any thing to disturb its rate; whereas Christ Church clock has four external dials, each having both hour and minute pointers; and it is to be noticed also that very boisterous weather happened during the time these observations were making on its rate.

But though we profess to make clocks of a very superior kind to the one at Christ Church, we make none of an inferior sort, it having only a common wooden-rod pendulum. And although it may be considered superior to most clocks on account of having roller-pinions, yet its chief superiority is in the escapement, which is the inferior one of my invention on the detached principle, which rolls in and out; and by means hereof the pendulum can scarcely receive any perturbation, the greater part of the irregularities being hereby cut off.

Mr. Wynn gives a curious reason for the durability of "horological machines," viz. that they must be made durable in order to keep good rates. Were I to give a reason for their durability, it would be *the slowness of their motions*, whereby they do not wear so much in a hundred years as some machinery does in a month. For instance, the best speed of a mill-stone of 4½ feet in diameter and perhaps near a ton weight, is about 100 revolutions in a minute, and it continues to run at this rate for length of days: and the machinery for dressing flour makes a much greater number of revolutions, to say nothing of various other machines which are kept constantly going, and the motions of which are far more rapid than those of a flour-mill. Whereas, the first

movements of clocks frequently do not make more than 3 or 4 revolutions in 24 hours; and as the motions in the train become quicker, the pressure becomes less, and the works are made lighter of course. What comparison then can there be between the wear of a clock and the wear of most other machines?

As to the dead-beat, which Mr. Wynn recommends the republication of, it is easy to demonstrate its principle to be inferior to that of the recoiling-pallets. I know there is a general predilection for the dead-beat; and I am well aware of its being an easy matter to give very specious reasons why it is the best—such reasons indeed as must needs be considered altogether conclusive, until their preponderance is overweighed by a *superior reason* being given why the recoil is preferable. This reason I may probably give in some future Number.

JAMES HARRISON.

Barton-upon-Humber.

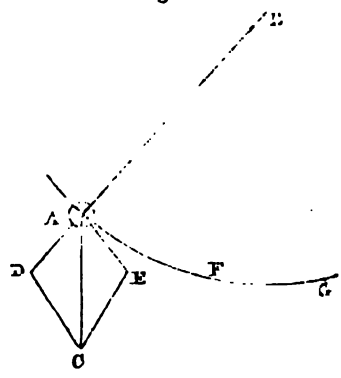
NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

(Continued from p. 271.)

The next thing to be considered is a very important one, viz. the centre of gravity. If there be several points separately attracted by the force of gravity, the different forces may be supported by one fixed point; and if these several forces act on different parts of a body, this certain point is one which has the same effect as those forces, and this point is called the centre of gravity. In considering the mechanical effect of a *solid* body, the whole of it, except that one point, may be supposed to be quite deprived of weight, whilst the whole weight or gravity is concentrated in that one point.

One of the properties of this point is, that it always descends, or endeavours to descend, in the straight line perpendicular to the surface of the earth, or as near that line as possible. Let A represent a body, fastened by a rod or string to the fixed point B. *Now the line* in which this body *would fall,* were it at liberty to do so by its own gravity, would be AC;

Fig. 1.



but this force may be resolved into the two other forces AD and AE, being the sides of a parallelogram, of which AC is the diagonal. But the force AD only stretches the rod, therefore AE is the only force which tends to produce motion, and the body will consequently fall in the curve AFG. If the direction of the rod AB be supposed to be more perpendicular than before, it is evident that the side AE will be much less, therefore the body will move with a much less velocity than before; and the velocity can be proved, in like manner, to be less and less, until at last, when the rod is exactly perpendicular, there will be no motion, the only effect being that of tension.

Consequently, if the centre of gravity be not directly under the point of suspension, the body will descend, or endeavour to descend, until it is exactly under that point; and this position is one of equilibrium.

But there is another state of equilibrium; viz. when the centre of gravity is *directly over* the point of suspension.

If the body be supposed to be in the *former* position, it is evident that any motion given to it must cause the centre of gravity to ascend; but one property of gravity being, as before stated, that it will always descend (or endeavour to descend), the body will return to its former position. Now it is different in the *latter* state of equilibrium: for there, the least motion given to it will throw it on one side,

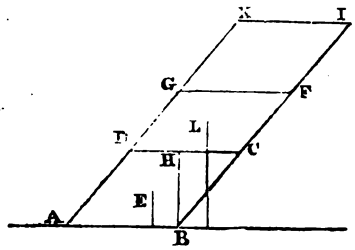
when it will descend; and, after vibrating, will settle in the *former* state of equilibrium called the Stable, while the latter is the Unstable, state of equilibrium.

However, these are not the exact definitions of the words "stable" and "unstable," as there are instances when they are exactly opposite, which would be the case supposing the body to be a small balloon filled with gas. But the true criterion for distinguishing the different states is this: the tate of equilibrium is stable, when, any disturbing force being applied to it, the body will return to its former position; and it is unstable, when it will move into the other state on being disturbed.

(The manner of finding the centre of gravity of a body, is too well known to need description.)

When a body rests on a base, its stability depends on the line of direction falling within that base.* Thus

Fig. 2.



let ABCD be a parallelogram, resting on the base AB. Now the line of direction, drawn from the centre of gravity E, falls within the base; therefore the body will stand securely. Now suppose another parallelogram, DCFG, be placed upon the former one, which together will make the figure ABFG; the line drawn, as before, from the centre of gravity H, will fall exactly at the point B. This position may be called the boundary between the stable and the unstable states of equilibrium: for although it may stand on its base, yet, on the slightest force being applied to it, it will fall over. Again, let a third parallelogram, GFIK, be applied, which will raise the centre of gravity to L: the whole figure ABIK will then fall over, and the line of direction will fall beyond or outside the point B of the base.

(To be continued.)

* The line of direction is a line drawn from the centre of gravity perpendicular to the horizon.

WHITE'S EPHEMERIS FOR 1830.

The Editor of "White's Ephemeris" presents his best compliments to the Editor of the "Mechanics' Magazine," and will be greatly obliged if he will allow him, through the medium of his extensively circulated publication, to specify a few corrections in that almanac.

Speculum Phænom. &c.—Errata.

P. 42. Jan. 1. — *Sun* in perihelio, should be *Earth* in perihelio.

P. 43. July 1. — *Sun* in aphelio, should be *Earth* in aphelio.

P. 42. May 4 —Mars in conjunction with Capricorn, dif. lat. 19′, should be Mars in conjunction with *iota* Capricorn, dif. lat. 19′.

P. 43. Sept. 2.—Moon eclipsed invisible, should be Moon eclipsed visible.

776 May, 166 May, &c. indicate the stars numbered 776, 166, &c. respectively in Mayer's Catalogue.

P. 48.—For Guroa, read Genoa.

Perhaps, also, the Editor of the "Mechanics' Magazine" will permit it to be observed, that the elements of the planet *Ceres* have received some slight corrections, in consequence of the recent observations of foreign astronomers; the result of which was not known in England until after "White's Ephemeris," for 1830, was printed. If these new elements should be accurate, the geometric right ascension of Ceres on the noon of April 30, 1830, the day of the approaching opposition, will be 14h. 44m. 28s., and the declination 4° 10′ 13″ S. The former differing about a minute in time; the latter, about 7½′ in arc from what are given at p. 36 of "White."

Woolwich, Dec. 16, 1829.

MINOR CORRESPONDENCE.

Patents.—Sir, I have observed that the greater number of patents granted for useful improvements continue only for a few months instead of years. I should be glad to learn the cause of this seeming barrier being placed between merit and its reward.

I am, Sir, yours, &c.

W.—(A Constant Reader.)

[Our Correspondent has mistaken the meaning of the phrases "2 months," "4 months," and "6 months," usually attached to the announcements of new patents; but he is not the first person, by some scores, we have known to labour under a similar apprehension. A brief explanation may therefore convey information to many of our "Constant Readers," besides the one who addresses us. After a patent is granted, a certain time is allowed to the patentee to lodge a specification of his invention. If the patent is taken out for England alone, the time usually allowed is two months; if for England and Scotland, four months; if for England, Scotland, and Ireland, six months. These are the customary periods, but they may be enlarged at the discretion of the Attorney and Solicitor-generals for the time being. The fixed duration of *all* patents is fourteen years; but an extension of the period may be obtained by application to Parliament, when it can be shown (as in the case of Watt), that, for particular reasons, the patentee has not had a fair opportunity during the fourteen years of reaping the reward due to his ingenuity.—EDIT.]

Sergeants Arabin and Denman.—We are authorised to state that Mr. Common Sergeant Denman, though a Member of the Superintending Committee of the Society for the Diffusion of Useful Knowledge, never saw *The British Almanac* for 1829, in which there is the omission complained of respecting Mr. Sergeant Arabin, until after its publication.

New Mechanical Motion.—Pendulum Power.—That Mr. Dixon Vallance is a very valuable Correspondent all who read your Magazine must allow; that there may have been a coincidence of ideas between him and a very old mechanic, I am ready to admit: at the same time it is only just to say that a power of the same kind was applied to an engine for raising water previous to the year 1635, an account of which, with a plate of the machine, I have in a book in my library, which was printed in the above year.

HOMO.

MISCELLANEOUS.

Effects of different Winds on the Colours of Vapours.—I wish to know if any of your numerous readers have observed that the particles of vapour, which are at all times floating in the air, refract different rays of light, or rather divide the rays of light differently (like a prism), with each change of wind? I have for a long time noticed (and living in a hilly country, where the views are extensive, I have an opportunity of seeing objects, such as high hills, at a very great distance, and with consequently a large volume of air between me and the object viewed), that with an east wind the air appears of a rosy hue—inclining to purple if north of east—to scarlet if south of east; with a south wind the hills appear clear and of their natural colour, and the air and sky white or paler blue than usual; with a west wind deep blue; with a north wind dark and gloomy, and if any fog with it quite black. The intermediate points of the compass partake of the nature of the more cardinal points between which they stand.—A.

French Method of making Mortar for Building.—The method used by the masons in some part of France, is to put the lime in a sort of trough raised on four legs, about 18 inches from the ground, and then to pour in sufficient water to slack the lime, adding, when properly slacked, more water, and stirring it until it is about the consistence of thin milk. At one end of the trough is a hole four inches square, covered with a wire grating, and closed by a wooden slide, or shutter: when the lime has been rendered liquid, as above, the shutter or slide is withdrawn, and the fluid runs out through the wire grating into a reservoir, formed on the ground by the well-sifted sand or drift, with which sand or drift the fluid lime is subsequently mixed to make the mortar. Is not this a cleaner way than our clumsy one of sifting the lime in the streets or roads through a coarse sieve, covering with a destructive white powder every thing near, and putting out the eyes of passers-by? It also makes a better mortar.—A.

INTERIM NOTICES.

We persist in our refusal. *Fidelitas* still leaves untouched our representation of the facts, which led us to the painful conclusion that Dr. Birkbeck did not state that which he knew to be the truth, when he described the London Mechanics' Institution as being "triumphant" and "prosperous;" and we are resolved not to open our pages to any *more talk* on the subject. *Fidelitas* had better make a speech somewhere, and get the Doctor's man to report it in the newspapers; truth and candour will then be matters of less consequence.

H. H.—No. 11.

Fact and Nothing Else is quite right. We did at first ascribe to Dr. Birkbeck the honour of "founding the first school in Great Britain for the instruction of mechanics;" but we were not then sufficiently informed with respect to all the circumstances of Dr. Birkbeck's connexion with the Glasgow Institution. It has been since established past all doubt, that Dr. Birkbeck was but a Lecturer in "the first school," and that the founder was a very different personage—the justly celebrated John Anderson. There was an address, it is true, got up by some mechanics of Glasgow, in which the honour was transferred from Professor Anderson to Dr. Birkbeck; but thereby *hangs another tale of cash lent*, of which more anon.

Lest any of our readers should think of purchasing *Adcock's Engineer's Pocket-book* for 1830, under an impression that the numerous numerical errors which we pointed out in that work for 1829, have been corrected, we think it right to apprise them that they are all—the very worst of them—very carefully preserved in this new edition. To use a celebrated phrase, *this is too bad.*

Communications received from Mr. Russel—R—s Fl—ms—Novice—Mr. Dowling—Clyde—E. S. L.—A Practical Engineer—T.—Mr. Gilbert—P. S. W.—A Youthful Treader on the World's wide Stage—G. R.—An Amateur Turner—W.—Mr. Jopling.

Errata.—P. 293, col. 2, l. 10 from the bottom, for *Lecroix* read *Lacroix*.

P. 294, col 1, l. 19, for p. 6, read p. 5

Ib. col. 2, l. 14, for "hours," read "three hours."

P. 295, col. 2, l. 7, for "at Weymouth 5h. 30m." read "at Weymouth 6h. 3m."

P. 299, col. 1, l. 14, for "$x^4 - 9x^3 + 6x - z = 1590$," read "$x^4 - 9x^3 + 6x^1 - z = 1590$."

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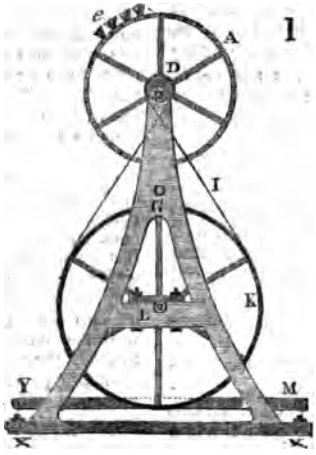
M. SALMON, Printer, Fleet Street.

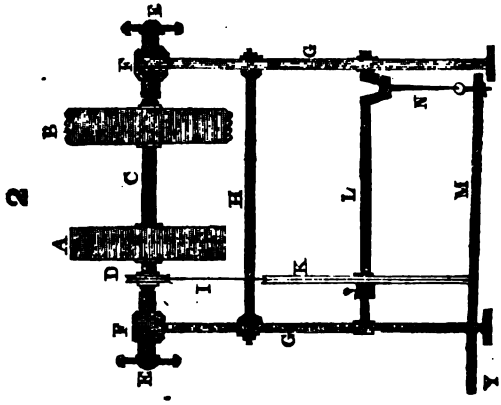
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 334.] SATURDAY, JANUARY 2, 1830. [Price 3d.

MECHANICAL KNIFE AND FORK-CLEANER.





MECHANICAL KNIFE AND FORK-CLEANER.

Sir,—Your correspondent, "L. A. an Innkeeper," wishes to be informed of some cheap and expeditious plan of cleaning knives and forks. Herewith I send you two drawings of a plan for the purpose that occurred to my mind on reading his inquiry; and as he is an innkeeper, I think he will find it also very useful in cleaning boots and shoes.

Fig. 1, *shows the end view, and* fig. 2, the front of the machine; the letters A, B, C, &c., refer to the same things in both figures.

A is a light iron pulley, fixed on the mandrill C, fig. 2. The rim of the pulley A is faced round with inch timber, round which a strap of thick, spongy, tanned leather, is well glued, which is again covered with a paste made of emery, or brick-dust, boiled in a little mutton-fat and bees'-wax, so that when cold it forms a solid body. This composition may be kept

in cakes, and rubbed on when the pulley is running; but the best mode to be pursued in these respects will be found out after a little practice. This done, motion is given to the pulley by the foot on the treddle M, which moves the crank-shaft L and pulley K, round which is the card or strap I, driving the pulleys D, A, B, on the mandrill C. The knife being then gently applied to the surface of the pulley A, the knife will instantly become bright, if sufficient velocity is given to the pulley.

The forks and hilts of the knives may either be cleaned by a stiff circular brush, as shown at *e*, pulley A, or by a pulley B, made of board, well glued and jointed together, and grooves turned in to fit the grains and swells of the forks, this must also be covered with the paste above-mentioned.

For boots and shoes another mandrill C must be used, on which, instead of the two pulleys A and B, two circular brushes must be put; the one for cleaning off the dirt, and the other for polishing with, after blacking. E, E, are two she-centres, in which the mandrill C runs, screwed through the boss F of the iron frame G, G. The frame-ends G are bound together by an iron pillar or stay H, and fixed to the floor by the two bolts X, X. The pulley K is 24 inches diameter, D 4 inches diameter, A and B 18 inches diameter and 4 inches broad. The treddle M works on two studs or pins at Y, Y.

Should you think the above worthy a place in your Magazine, you will much oblige me by inserting it, for the use of "L. A." or any other of your readers.

I am, Sir, yours, &c.

F.

Manchester, Dec. 2, 1829.

THE SOCIETY FOR THE DIFFUSION OF USEFUL KNOWLEDGE, AND THE TIDES.

We have received various communications from friends and correspondents on the subject of our review of Mr. Lubbock's dealings with the tides; some in which we are warmly thanked *for so thoroughly* exposing the gross *fallacy and* incorrectness of Mr. Lubbock's computations; and others in which we are charged with throwing an undue severity into our strictures. One very esteemed correspondent, in particular, hints that to make matters worse than they really are, we have *affected* to keep back some blunders committed by Mr. Lubbock; while, in fact, we have made the most of all we could find. Now so little ground is there for this unkind suspicion; so little disposed have we been to make *the most* of the case, as it stands, against Mr. Lubbock; so much has that severity with which a sense of duty to the public has compelled us to speak of Mr. Lubbock's speculations, been tempered by a feeling of indulgence towards Mr. Lubbock personally—that we have, in truth, kept back more blunders than we have set forth, and some quite as gross as any which we have made public. One example may suffice to satisfy our friend on this point; as well as any others who may have felt, like him, inclined to doubt the predominance of a compassionating principle in our critical nature. At p. 57, of the "Companion," there is a table of "Times of High Water," taken "from the Tide-Book;" and at p. 58, a table of "Moon's Time of Southing," taken "from the Nautical Almanac." From these two tables, and similar ones, Mr. Lubbock deduces means by methods which we have characterised (p. 310, of our last Number) as being "from the beginning to the end objectionable." A good many reasons for thus characterising it we have laid before our readers—more than enough, we apprehend, to satisfy any competent judge—but the still stronger reason than any which we have now to notice we *kept back*, simply because we would not bear harder on Mr. Lubbock than was absolutely necessary. The hours and minutes taken "from the Tide-Book" are in mean or *clock* time, as Rotherhithe Church clock (!!!) can testify; while the moon's southings in the "Nautical Almanac," are given in apparent or *solar* time; and Mr. Lubbock has in making his comparison and deducing his means, gone on the supposition that the time in both instances was the *same!* He has never thought of reducing the apparent or solar to mean or clock time!! Now every one knows that in February and in part of January and March, the clock is nearly a quarter of an hour *before* the sun, while in greater part of October and November the clock is a quarter of an hour *later* than the sun; and that only four times a year do the

mean and solar times agree. How irrational must that devotion to theory be, which leads a computer to neglect such a source of error as this; of error, so great, that Mr. Lubbock's computations may from this single cause alone be wrong to the extent of not less than *half an hour at a time* (a quarter of an hour each way)! Surely no person whose mind is open to conviction can stand up for the credit of computations thus carelessly made; or ask of us farther proof of the justice of that sentence of condemnation which we have felt compelled to pass on Mr. Lubbock and his lucubrations.

CYLINDRICAL RAILWAY-CARRIAGE.

The following account of a very novel and ingenious description of Railway-carriage, invented by a Mr. P. Fleming, engineer, at New York, is given by Dr. Jones, the superintendent of the Patent-office at Washington, in a recent number of the Journal of the Franklin Institute:—

"The carriage is a cylindrical body, which may have an axis passing through it, or gudgeons affixed to and projecting from its ends, for the purpose of drawing it. The wheels are iron rims placed around the cylinder so as to encompass it like hoops; these stand at a proper distance from each other, to run upon the rail; they are provided with flanches, or have their faces finished in any form suitable to the rail upon which they are to run. In the inside of the cylinder may be stowed boxes, barrels, bales, or other goods to be transported. When bars of iron, lumber, or other articles of considerable length have to be carried, the traction is performed in a different way; the carriage is then a hollow cylinder, not furnished with ends; the iron bars, boards, or plank, are passed entirely through it, and, of course, do not admit the employment of an axle, or gudgeons. In this case an endless rope is passed round the middle of the cylinder, which is furnished with double rows of pegs to form a groove, or checks, to retain the rope, or band, in its proper place. This rope also passes over a pulley, which is attached to the horse, or other drawing power, so as to work like the large and small wheels of a lathe with their bands. Two, three, or more cylindrical carriages may be made to follow each other, when connected by bands in the same way.

"Under this arrangement it is evident that whatever is carried must roll with the carriage; but in transporting some kinds of goods, and particularly in carrying *persons*, this would, to say the least of it, be very *inconvenient*. To obviate this objection, a second cylindrical body is placed inside of the first, and is made sufficiently small to revolve within it. This is suspended upon the axis, or gudgeons, and is weighted on one side; so that whilst the outer cylinder rolls upon the road, the inner one will not revolve with it. It is proposed sometimes to make this suspension by the agency of friction-wheels, so as to leave but little more friction than that which results from the rolling of the carriage. The patentee says—

"'What I claim is the use of a cylinder, or other volume of revolution, on a railway, as a carriage, or vehicle for transportation.

"'I also claim as my invention the use of the endless rope in the manner above described for progressive motion. By means of this use of the cylinder and traction-rope friction is saved or avoided to a greater degree than by any machine now known. The traction-rope may be employed separately from the cylindrical railway-carriage in any other machine where similar progressive motion is required.'"

ON THE ALLEGED IMPROVEMENTS IN STEAM-ENGINES CLAIMED BY MR. GILMAN.

Sir,—I have been greatly amused, and at the same time not a little surprised, by the perusal of the article in your 330th and 331st Numbers, dignified with the appellation of *Gilman's Steam Generator*. There is such an extreme want of candour and so much art in Mr. Gilman's paper, that I think those who have read it should have this analysis thereof submitted to them. It takes up the paper at the commencement, and proceeds with it paragraph by paragraph to its conclusion.

The three very first lines of the first paragraph contain a most uncandid and incorrect statement; they run thus—"In 1826 my attention was directed to the best and most economical method of generating steam, &c." Why does Mr. Gilman say in 1826? Did he not take out a patent, dated April 13, 1825, "for certain improvements in generating steam," &c.? Is he ashamed of his labours previous to 1826? I presume that is the case; for certainly if any thing can exceed the absurdity of Gilman's generator of 1826, it is Gilman's patent of 1825. As I think them companions, too worthy of each other to be separated, I copy the following conclusion of the specification of that patent:—"And we do hereby expressly ascertain and limit our claims under the hereinbefore in part recited patent to the following particulars (that is to say), First, we claim the principle of spreading thin sheets of water, by means of revolving agitators, over the internal surfaces of cylindrical boilers when placed horizontally, or but moderately inclined in the modes hereinbefore described. Secondly, we claim the particular arrangements of the tube-lined fire-place and flues, which are shown in figs. 1, 2, and 3, and described herein with their several modifications, that are mentioned for the purpose of heating the water previously to its being introduced into our boilers. Thirdly, we claim the mode of connecting and joining together our tubes or pipes in each of the tiers, which is shown in figs. 4 and 5, and described herein. Fourthly, we claim the having of a forcing-pump or pumps constantly attached to the boilers, or steam-pipes or chambers, for the purpose of readily proving their strength on all necessary occasions. Fifth, we claim the applying of tar or pitch, either mineral or vegetable, to increase the inflammability, and perfect the combustion of ordinary fuel for the generating of steam; and, sixthly, we claim the principle of using high-steam in two or more steam-engine cylinders, without condensing, to assist our engine by the vacuum formed thereby, in the manner hereinbefore *described*. In witness whereof, &c."

Now I would ask, as relates to the first of these claims, what, in the name of common sense, can be the use or advantage of agitating water in *close* vessels for producing steam? Secondly, how could water possibly be passed through such an immense length of tubeing placed in a furnace, without its being converted into steam, long before its arrival at the boilers? Next I would ask, what possible originality or novelty is there in the third and fourth claims for joints and force-pumps? The fifth claim, I admit, has great merit, as the *originality* and *stretch of genius* in burning tar and pitch along with ordinary fuel are very great indeed.* I lastly, in order to show the originality of the sixth claim, refer your readers to a patent taken out by Mr. Arthur Woolf, dated June 7, 1824; the specification of which describes the use of two cylinders in a similar, but better way than that pointed out by Mr. Gilman.

For further information respecting Mr. Gilman's patent, I refer such of your readers as are fond of such *shimble shamble* stuff to the patent itself, and shall now proceed with the paper more immediately in question.

The second paragraph commences thus—"In that year the apparatus, exhibited by the accompanying drawings, was executed, and is now in existence." This *ipse dixit* it is not within my province to deny; but, in reply to his statement, that from 200 to 300 lbs. per inch pressure were employed by it, I will fearlessly assert that he never did and never could do any such thing. So far from his doing that, I will challenge him to prove that he ever with that apparatus (and in the way he describes) subjected the fuel to combustion, under a pressure of so much as 1 lb., much less of 300 lbs. to the square inch, above the pressure of the atmosphere. If the apparatus be really in existence, he can easily, before competent witnesses, disprove the assertions I have already made, as well as those I shall make in the course of this letter.

As the third and fourth paragraphs of Mr. Gilman's paper describe his

* Two patents were taken out for the same wise purpose by Mr. John Christie; the first dated Oct. 9, 1823, and the last Feb. 28, 1824. so that even here Mr. Gilman is not original.

generator and the mode of operating with it, I will now point out *some* of its defects and incongruities, and the total impossibility of his doing with it what he has stated, which will prove that the *use* of such a generator, if not indeed (as I shrewdly suspect) the generator itself, is merely the chimera of the same brain that concocted the patent of April 13, 1825.

In the first place, a vessel of 2 feet in diameter, with the bottom and cover attached to it by only 12 bolts, in the manner shown by the drawing, is no more capable of bearing a pressure of 200 or 300lbs. on the square inch, without suffering the steam to escape, than it is of bearing a pressure of 2000 or 3000lbs. per square inch. I would ask Mr. G. how the inner and outer cylinders of the generator are united to the cover and bottom, so as to support even a very low pressure without flanches, each cylinder being only one inch thick? He has certainly hit upon one great excellence of the top of his generator, viz. that it acts like an immense safety-valve! It will, indeed, act so, and let out all high-pressure vapours, as I have before stated; but why he has not paid the same compliment to the bottom as well as the cover I don't know, for it is evident it will produce the same effect, so that Mr. Gilman has the advantage of two immense safety-valves!!

In the second place, Mr. Gilman's description of the mode of operating with his generator is impracticable. He says—"In using this generator the method of operating is first to fill the fire-chamber *full* of fuel, and when the fuel has acquired a state of intense ignition, the cap of the flue, &c.' Now, as he says the internal cylinder is 18 inches diameter at the bottom, it must, as shown by the drawing, be about 2½ times that depth, or 45 inches deep. Now, I defy Mr. Gilman, or any man living, to get half that depth of fuel into a state of *intense ignition* by blowing in air in the way he has mentioned. About 12 to 15 inches deep of fuel is all that can be got into that state; for when a quantity of fuel is put in at the top of the cylinder, that at the bottom *is so far consumed* before that at the top gets to a red heat, as to cause the whole mass to be reduced to the depth above mentioned. I speak not from theory but from practice on this point; if I am wrong, Mr. G. can easily contradict me; for as his apparatus *is now in existence*, he can easily, before witnesses, show whether he can get 45 inches deep of fuel into a state of intense ignition. What I have said proves that he has *not used* such a generator as he describes even experimentally, and this I am about to prove still more fully. I will even show that between the time of making his drawings, and that of giving his descriptions thereof, his fertile genius came to his aid and pointed out an alteration in his apparatus. For, in the drawing fig. 2, the pipes F are shown as branching from nearly the top of the internal cylinder above the water; while in the 7th paragraph of his paper he says "the four pipes F, instead of being attached to the fire-chamber *above* the fire, should be fixed about the *middle* of the burning mass." Now it is quite clear if he had really used the generator, and that his description were the result thereof, the drawing would have shown these pipes in the middle of the burning mass, and it is equally clear that something struck him in the time that elapsed between the drawing being made and the above alteration appearing in the description thereof. I suspect the reason for the alteration was this, that as one air-pipe A enters underneath the grate and below such an immense mass of fuel, and the other pipe branching from it enters above the fuel, it struck him that all the air would pass into the generator by the last-mentioned branch, and of course *above* the fuel; the obstruction of such a mass preventing any from passing below and through it, as air, like other fluids, will take the passage the least obstructed. Perhaps also he thought (not without reason) that the pipes F, if out of the water, would soon be destroyed by the fire; but in avoiding being wrecked upon Scylla, he has engulphed himself in Charybdis: for if the pipes F be fixed about the middle of the burning mass, it is evident they will in a few minutes be choked

by small bits of fuel and ashes being blown into them, when Mr. G.'s valves at the bottom of the pipes L would be kept open by such ashes, &c., and the water would get into the fire-chamber. What would then become of poor Mr. G.'s burning mass? But supposing such burning mass met with no such dire misfortune, what would become of the ashes and scoria formed on the grate by the combustion of the fuel, even in a mere experiment? Where is the ash-pit and the means of withdrawing them? The former, it is true, might be blown into those useful pipes F, but a blast would in a very short time produce so much scoria or slagg as would effectually prevent any air from passing through the fuel. Even if there were not such an immense depth of it as Mr. Gilman describes, and all the air were to pass above the fuel through the pipes attached to the two orifices L, the fire must consequently be extinguished.

Have I said enough, Mr. Editor, to prove that the pretence of this apparatus having been really *used* even experimentally, cannot possibly be founded in fact? If not, I will trouble you a little farther. Mr. G. does not even pretend that having once closed up the fuel, he could introduce any more; for if he had a means of so doing, he would gladly have included it in his drawings and in his description thereof. I really think I need not enter into the very obvious reasons why without such a means of feeding the fire, the generator could not be put into operation at all. I recollect when I was a boy, either hearing or reading a sermon (I forget which) preached by a divine (you will say a no very learned one) from a part of the 12th verse of the 10th chapter of Joshua, "*Sun, stand thou still upon Gibeon.*" He divided his sermon into three parts, consisting, as he said, of the three several motions of the sun—first, there was, he said, the direct motion of the sun; secondly, the retrograde motion of the sun; and, thirdly, "the MOTION mentioned in my text—*the sun stood still.*" Now for the application. I have no doubt *the motion* of any engine to which *Mr. Gilman's* generator might be applied, would be the third motion or division of the preacher's sermon—*and the engine stood still.*

Apologising for this digression, we will proceed to Mr. Gilman's fifth paragraph, where he says, "With respect to combustion *under great pressure*, I have never discovered but that it proceeded as well in that way as by common draughts under the ordinary atmospheric pressure." I fully believe him here; I believe he *never did discover* but that combustion proceeded as well under great pressure as under the ordinary atmospheric pressure; for this plain reason, that he never *produced* or even *saw produced* the combustion of fuel *under great pressure* for the purposes he points out. I beg to refer to two patents taken out by Mr. Samuel Hall, the first dated April 8, 1824, and the second dated May 31, 1828; no one on inspecting them will doubt for a moment that Mr. Gilman's ideas upon combustion under high-pressure are *borrowed* therefrom, and that in fact Mr. Gilman's generator is a *rude* imitation of the generators described in Mr. Hall's two patents.

As to Mr. Gilman's crude philosophy, in which he indulges in his fifth and sixth paragraphs, we will not dispute the matter with him, as I am more (as my name indicates) for practice than theory; I will merely say that in his great *simplicity* he takes no notice of the immense volume of gases resulting from the combination during combustion of oxygen with the carbon of the fuel. Poor carbonic acid, &c. how greatly you are neglected by Mr. Gilman!

I now proceed to paragraph the eighth, containing two modifications or flights of Mr. Gilman's genius, some of which, he says, have been put in practice. I wish he would from the result of such practice inform us how soon, according to the first modification, the top of the generator and pipes F (when so unfortunate as to be taken from their protector, water) become red-hot, and how soon they would be destroyed. With respect to the second modification, it is clearly intended to be a hard blow at Messrs. Braithwaite and Ericsson, who have really brought a very useful locomo-

tive engine into practice. To them I am fully of opinion he is much indebted for this modification, and to the patents I have already pointed out, as well as to another I am about to mention, in consequence of the ninth paragraph containing Mr. Gilman's last modification. Let any person read the specification of a patent taken out by Mr. William Wilmot Hall, dated January 15, 1827, and they will be convinced that this modification is taken from it almost literally. I must also refer to the patent taken out by Messrs. Burstall and Hill, of February 3, 1825, and to one taken out by Mr. James Neville on March 14, 1826; and then I leave it to every one to judge how completely Mr. Gilman has ransacked the patent-enrolment offices to collect together the heterogeneous mass contained in his paper, published in Nos. 330 and 331 of your Magazine.

Having made my comments upon the part contained in the former Number, I should have proceeded to do the same with that contained in the latter, but I am afraid of tiring your patience with so long a letter; and, in fact, although the remainder of the paper inserted in No. 331, contains a variety of absurdities, they arise principally out of matters which I have already discussed, and consequently are too obvious to require farther explanations.

As I perhaps may not be allowed by Mr. Gilman to style myself, like him, a *Civil*, I must be contented with subscribing myself,

Sir, yours respectfully,

A PRACTICAL ENGINEER.

[A "Practical Engineer" has imposed a painful duty upon us in requiring us to give insertion to this sharp attack on an esteemed friend and correspondent; but in this, as in every similar case of contested pretensions, we feel that we have but one course to pursue, namely, to give all parties, whether friends or strangers, a fair hearing. *Amicus Plato, amicus Socrates, sed magis amica veritas.* If the charges brought against Mr. Gilman by our present correspondent are well-founded, it is but fair they should be made public; if they are otherwise, Mr. Gilman can be at no loss to refute them, and will suffer nothing by the opportunity which his reply will afford him, of re-asserting the merit of the inventions to which he lays claim.—EDIT. M. M.]

LIEUT. SKENE'S PADDLE-WHEELS.

Sir,—In a former letter I mentioned having fitted a boat with tread-wheel paddles, and now have the pleasure of sending the results of my experiment. The boat was small for the purpose, but proved all that I wished to prove, namely, the superiority of my patent-paddles over those in use at present. The tread-wheel held two men, and was two feet in diameter, the pinion or shaft-wheel was eight inches diameter. The weight lifted by the power of two men on the wheel and the present paddles was 80lbs., and the weight lifted by the same power but with my patent-paddles was 102lbs. One striking proof of the difference between the paddles was that the old paddles wetted the men on the wheel, while the new paddles left them without a drop to signify. I derived the proof also that wooden paddles were as good or better than metal ones. As most patentees are accused of thinking too highly of their own hobbies, I refer you and others interested to Mr. Thomas Pritchard, foreman shipwright, Rotherhithe, who was present at and assisted in the trials, for a more particular account of the same.

While addressing you, I am tempted to inquire if any of your readers know of any set of experiments made by engineers or others to prove whether my paddles are or are not better than the present paddles? If so, I should wish them given to the world through your valuable pages; and if no such trials have been made, I still assert that engineers are not the inquiring disinterested men they ought to be.

I take this opportunity to say, that last summer I built a steam-boat of fifty tons on a new plan, that is after my ideas of what a steam-boat ought to be. Should any of your readers

wish to see her they will find her in the Surrey canal; she is for sale without engines.

One word to Mr. Hebert, editor of the Register of Arts, Engineer, &c. Does he still think, or rather say, that a vessel fitted with my machinery would not reach Greenwich in one day against the tide? If he does, let him exhibit his proof.

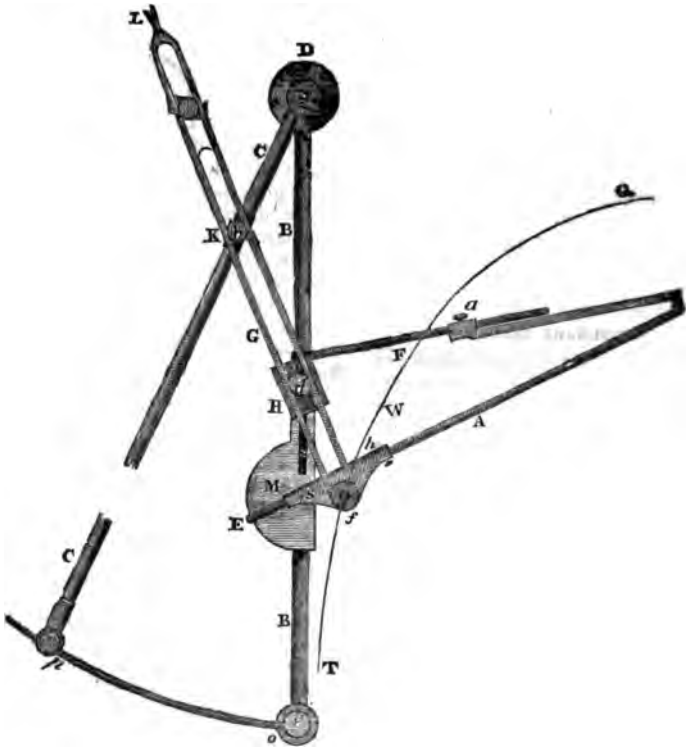
I am, Sir,

Yours respectfully,

A. M. SKENE.

49, *Fenchurch-street*,
Dec. 26, 1829.

DESCRIPTION OF AN INSTRUMENT, INVENTED BY MR. K. CHILD, FOR DRAWING HYPERBOLAS.



A, B, C, are three cylindrical rods, on which move freely the respective slides *h*, M, and K. C moves on a centre at the flat end of B, as at D, and can be set by means of the arc *o*, *p*, to any required angle with B. A can likewise be adjusted by the assistance of the sliding-socket on F, and the thumb-screw *a*, to any angle with B. The flat bar G has a groove in which are placed the pins or centres of the slides K and H, which can be secured in their respective situations by the thumb-screws *b*, d, the one in the groove *n*, (in the slide M) and the other on the rod C, but at the same time allowing G to move freely round them. The rod F moves on a centre on the slide M.

The centre of motion of A is at S, (exactly over the centre of the rod B), and for the sake of steadiness it has a notch on the inside of the end E, through which it moves round the semicircular part of the slide M, when under adjustment for the required angle.

In this arrangement of the instru-

ment the rod B represents one of the assymptotes of the intended hyperbola, and the rod A is always parallel to the other.

The slide *h* moves along the rod A, and at the same time allows the flat bar G to move freely round the socket *f*, in which is placed the tracer.

Now, if motion be given to the bar G by the handle L, the tracer at *f* will describe the hyperbolic curve QWT.

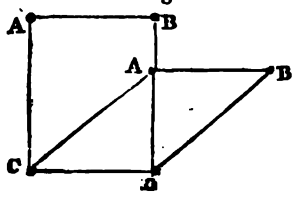
It may not be improper to remark, that any other point in the bar G, except that where the tracer is fixed, describes a peculiar kind of curve, whose properties it may afford the mathematical reader a little pleasure in investigating.

The rod C is more essentially necessary when hyperbolas are drawn by this instrument under a different arrangement of its parts, or when used for describing other curves.

SEPTENARY SYSTEM.

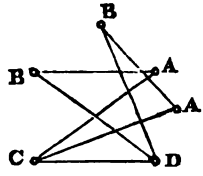
Sir,—At p. 351, vol. x. I alluded to a case of motion in the septenary system, by which lines with a single cusp, resembling the cardioid, are described: that case I then stated had the line or locus of the cusps an ellipse. This intimation having exercised the ingenuity of Mr. R. C. jun. when he recently favoured me with a call, he inquired if it was to the rolling of an elliptical wheel upon another equal and similar to it that I had referred? Having stated that the primary principles of the septenary system are confined to the pole, the right line and the circle, I of course told him it was not by elliptic wheels that the motion, which I considered remarkable, was produced. Having, however, explained to him the case of double-crank motion, to which my mind had been directed, it immediately appeared that the motion of a surface was thus regulated in exactly the same way as it would be if attached to an elliptical wheel rolling around another equal and similar to it. These cases of harmony, which I had not anticipated, will, I trust, greatly facilitate a knowledge of the nature of the curves of the first division; *some of which* are now evidently elliptical-epicycloids, while others are hyperbolic-epicycloids. The nature of the double-crank motions by which these effects are produced will appear distinctly, it is hoped, by the following diagrams and explanations:—

Fig. 1.



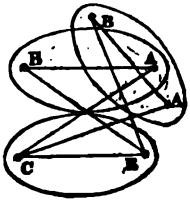
Let AB, AC, BD, and CD, (fig. 1.) be four pieces of wood, metal, or any other material, (the opposite sides being equal) connected together and moving freely on pins or centres at the angles. If the piece CD be fixed and the other three pieces be in motion, AB may be so moved that it will always be parallel to CD; but when AB comes to be in a right line with CD, the motion of it may be changed from parallel to angular, as in fig. 2.

Fig. 2.



In this case the cranks AC and DB cross each other, and their intersections will describe an elliptical line. The path of the intersections is the line of the cusps, both on the moveable plane attached to AB, and on the plane at rest, to which CD is fixed.

Fig. 3.

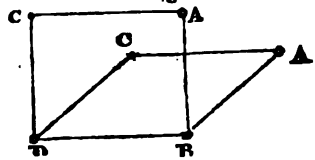


A and B being the foci on the moveable plane, and C and D on the

fixed plane. From this diagram it will appear that the circumference of the ellipse or line of the cusps on the plane in motion continually coincides with the circumference of the ellipse or line of the cusps on the plane at rest; and that if elliptical wheels corresponding with these lines of the cusps are substituted for the four pieces, a plane attached to one, while it rolls against the other, will be regulated precisely in the same way as if attached to the bar AB, regulated by the two cranks AC and DB.

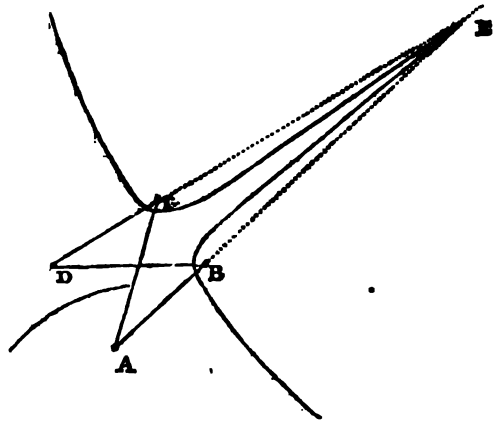
In fig 1, CD, one of the short pieces, was supposed to be fixed; let now DB, one of the long pieces, fig. 4,

Fig. 4.



be supposed to be at rest, the line CA will then have a parallel motion until it comes in a line with DB, when it may be changed into angular motion, as in fig. 5.

Fig. 5.



Here the continual intersections of DC and AB produced, will describe an hyperbola. The path of these intersections may be drawn either on a plane in motion attached to CA, or on a plane at rest, to which DB are fixed, and will be the line of the cusps in both cases. The circumferences of these hyperbolas on the two planes will always coincide; and if moulds be cut to the form, they may be substituted for the cranks, and will produce the same motion to a limited extent by rolling the one upon the other. But as the hyperbola is an infinite line, no mould, however extended, can contain the whole; therefore the whole of an hyperbolic epicycloid, although only a finite line, cannot be generated by hyperbolic moulds, but it may be done by the double-cranks.

In former papers it has been stated that by *double right-lined motion* the same effect is produced as by the rolling of one circular wheel within another of a certain proportion; and we now see that by *double circular motions* the effects of cases both of elliptic and hyperbolic external epicycloidal motions are obtained.

As elliptical wheels are sometimes used in machinery, it may be worthy of consideration whether the cranks can be substituted with any advantage either for the wheels themselves or for rendering teeth in them unnecessary. If cranks are used, one elliptical wheel may be made to roll around another without teeth; but it

may be perhaps necessary to have certain pins to prevent the cranks passing from the angular to the parallel motion.

I am, Sir, yours, &c.
JOSEPH JOPLING.

P. S.—Since writing the above, some ideas have occurred which lead to the supposition that all the lines generated by the first division may be epicycloids of the lines of their cusps.

BREAKING INTO HOUSES ON FIRE—BUILDING ACT.

Sir,—I think Mr. Baddeley, jun. has taken, perhaps, a too hasty view of the notice I ventured to send of the practice of breaking open the lower part of a house as *soon* as it is discovered to be on fire.

Had Mr. B. not denied the motive which he appears to think I would lay to his charge for commenting upon my good intentions with such a spirit, I certainly should have supposed that manner could not have proceeded from the desire of preventing what he imagines *now* to be erroneous to pass unnoticed.

I say *now*, because Mr. B. at p. 309, vol. x. says, when a person in the street discovers a house on fire, "*his first care* should be to make its inmates and their neighbours aware of their danger. This being done, the alarm should be given to the nearest fire-engine station." Not a word about "breaking open the door." Nor could he with any propriety have introduced such a direction before either of the above.

Although Mr. B. has not spoken very respectfully of any of my plans, yet he has of my intentions. However, I find that one of them, which perhaps he overlooked, has found its way with some modification into the columns of "The Englishman's Almanac" for 1830. I allude to making a hole through the roof and ceiling of the attic (vol. ix. p. 68). In "The Englishman" this is stated to be "an effectual method of escape," and "in the power of almost every description of persons." There it is stated that the inhabitant may, by getting upon a chair or table, &c., make these holes of escape for himself. The difficulties which may sometimes be met with are, however, greater than are there contemplated. When the roof is covered with slate boarding, it will require something more than "a bold thrust" to remove it: and the difficulty will be still greater, if a gutter or lead flat be in the way. Such holes of escape may of course be much sooner made by a person on the outside with proper tools; and this method ought not to be lost sight of.

I feel greatly obliged to Mr. B. for calling attention to my favourite plan to *save life*, when no other means of relief can be obtained; viz. "breaking a hole through the party-wall." The contemplated remodelling of the building-act offers an opportunity of rendering such a method legal, and if accompanied by an offer of reward, which Mr. B. has pointed out as an essential stimulus, would be every thing required; especially if the recommendation of Mr. Ainger and Mr. Elmes, that the upper part of party-walls may not be made unnecessarily thick, be attended to.

Such a method of escape is only required for upper rooms, where, of course, it must be obvious, that those holes about a foot square, would not have the same effect in fanning the flames in lower rooms as the breaking open the street door: which Mr. B. will not, I suppose, again find fault with me for objecting to, as the *first step*, if either the cry of fire, knocking at the door, or ringing the bell, will alarm the inhabitants, whose safety in every case ought to be the first consideration; and nothing, if possible to be avoided, ought to be done that will add to their danger.

Having alluded to the remodelling of the building-act, permit me to mention, that one of the gentlemen just named, considers that the *rate* of buildings ought not to be determined by the horizontal area, as is now the practice, but that it should be determined by the height. I think, however, that both ought to be taken into consideration; or, which is the same thing, either the inclined diagonal area of the loftiest story, or of all the

stories, should determine the rate. Farther, this area ought to be exclusive of the space occupied by those walls and partitions which extend from the bottom to the top of the house.

I am, Sir, yours, &c.
Dec. 3, 1829. J. S. S.

ENGLISH MONEY SYSTEM.

Sir,—As Dr. Lardner's attention has lately been directed to the philosophy of arithmetic, I beg leave to transmit for publication in the "Mechanics' Magazine," the following extract from the Arabic papers in the Library of the Escurial:—

"The most eventful revolution in religion and government was effected by an arithmetician, 'who could neither write nor read.' Mahomet, having divided the votolo, or pound of Mecca, into 12 oukias, or

480 dirhems,

reduced tithe to 2½ per cent.=1-40—12; and triumphed."

"In the 479th year of the Hegira, and after the battle of Zaira, near Badajos, a coin of 12 dirhems was struck by Yousouf Ben-Taschfin, and was then adopted by sectarian Mahometans and several Christian states for a divisor. The see of Rome was so opposed to those Arabic divisions, that the Arabic cyphers were not generally employed throughout Europe until after the Reformation."

Here it may be asked, Why are the Chinese and the Japanese systems of reckoning conformable to St. Andrew's ×, while the British is conformable to *bad* Mahometanism?

Dr. Lardner, as an historian, may say that Hindostan has been conquered *from* the Mahometans, *for* the inhabitants; but, as an arithmetician, he must acknowledge, that the inhabitants have not as yet discovered any difference between the *bad* Mahometan and the English system of reckoning.

When Mahomet declared the votolo of Mecca the standard weight of the faithful, he also declared, but most certainly not in the language of *prophecy*, that the relative value of silver to gold should be as 10 to 1; that is, the ½ dinar, or dinero, for the tithe commutation of 20 dinars. Christopher Columbus upset this relation; or, as the Chinese have it, the relation is all a *tale*. Just as our political journals have for the last three or four months been *insisting* that the United States make no more of 1000 Chinese cash than 6*s.* 8*d.*; though the United States reduced their system of reckoning one-sixth upon *kicking* the English, or Anglo-Mahometan system, *out of every court of justice throughout the States.*

The United States have acted right—because they have acted in obedience to the 25th chapter of Deuteronomy. In *The Times* of the 16th of May, a writer ("Americanus") exclaims, "How fortunate for unborn generations were the Duke of Wellington to assimilate the weights and measures of the world!" As a neighbouring people say (who, by the way, returned to the Christian standard in 1793) "Le premier pas *se coute.*" This is the financial part for His Grace's history.

I am, Sir,
Your very obedient servant,
Dec. 11, 1829. T.

THE RAILWAY SYSTEM.

Sir,—As your first, and consequently your oldest correspondent on railways (see Nos. 19 and 51 of your Magazine), I beg to transmit you the accompanying printed papers, and to solicit your particular attention to Circular No. 5.

These papers have been transmitted in all directions throughout the kingdom, and hundreds of them sent to Members of both Houses of Parliament.

Much speculative matter has been written upon friction or adhesion; and although it may appear very plausible in this early stage of the railway scheme, yet time, experience, and truth, will eventually show the errors of such writers.

I shall not now enlarge upon the subject, but only remark that had the good citizens seconded my petition to the Corporation of London, sent specially to Mr. Waithman in 1824, and inserted in the *Morning Chronicle* of

30th November, 1824, and *Courier* of 2nd December thereafter, coal would have *now* been selling at 15s. per chaldron, instead of the present abominably high price.

But it is difficult to say, whether the Corporation of London or the inland proprietors of coal are most to blame.

I remain, Sir, respectfully,
Your obedient servant,
THOMAS GRAY,
(the original projector of the railway scheme.)
Nottingham, Nov. 13, 1829.

P.S.—My work, "Observations on a General Iron Railway, &c., was published by Messrs. Baldwin, Cradock, and Joy, *many years* before any other individual had written a line upon the subject.

The papers transmitted to us by Mr. Gray, and the published work to which he refers in his postscript, establish very clearly the fact of his having laboured assiduously, as early at least as the years 1822 and 1823, to press on public attention the superiority of railways over turnpike-roads and canals, and the great gain to be derived from the substitution of steam-power in lieu of horses.

Mr. Gray's favourite project appears to have been the formation of a "Grand Trunk Railway" between London and Edinburgh, with branches extending to all the populous districts on both sides of the line. The numerous advantages likely to result from such a general railway are very well stated in the paper No. 3; but we have only room to give that part which serves to illustrate the paragraph in Mr. Gray's present letter respecting its favourable influence on the coal trade—

"The coal annually consumed in London alone, amounts nearly to two million chaldrons; and there can be no doubt that were this article considerably reduced in price in the capital, that the consumption thereof would soon reach double this quantity. The collier averages, perhaps, a voyage in each month, and returns from London in ballast. The locomotive engine would impel a gang of coal waggons, carrying the full freight of a collier, from Newcastle to London in *three days*, and return with the waggons loaded for the different districts through which the railway might pass, making the whole journey from Newcastle to London and back again in one week, yielding annually the profits of *fifty-two* journeys in lieu of *twelve* voyages. The voyage by sea is about 500 miles, by the railway the distance will be reduced nearly to 200 miles."

The circular No. 5, to which Mr. Gray invites our particular attention, is of a recent date (August 1, 1829), and intended to show, first, that cog-rails are preferable to plain-rails; and, secondly, that neither a system of inclined planes with stationary engines, nor a series of reciprocating steam-engines, is half so good as a level railway with locomotive engines. We apprehend that the recent experiments on the Liverpool and Manchester railway—those particularly which we noticed in our last week's Number—must by this time have gone far to satisfy Mr. Gray, that on the first point he is much in error, and we shall therefore pass over for the present what he says in regard to it. The observations which he makes on the second matter in dispute have our entire concurrence, and we quote them with much pleasure—

"I fear lest the public should be persuaded to follow the plans adopted in the collieries, by having recourse to inclined planes, stationary steam-engines, or the reciprocating steam-engine, all which may be useful in small private concerns, or where the coal-trade is the only business carried on; but, on railways for, national purposes, they should be avoided as much as possible, for this plain reason; the multiplicity of machinery—the consequent expense attending the annual waste of capital, and the accidents which would unavoidably occur from their general adoption on public lines of road, are quite sufficient to arrest the attention of companies in order to consider well before they commence laying down the rails.

"As there appears, however, a disposition to establish inclined planes, with stationary steam-engines, rather than incur the expense of leveling the whole road in a direct line, it becomes my duty to offer a few more remarks in opposition to this course, which would multiply the number of steam-engines in an excessive degree. It is my humble opinion that the number of engines likely to be required on the inclined planes would, if converted into locomotive engines, very shortly defray the expense of leveling the whole line of road in every direction. The question is not, what a stationary engine may do as an auxiliary, but how much more effective the power when employed as a locomotive engine? Moreover, the number of stationary engines required, should inclined planes be resorted to, would, if converted into locomotive engines, be sufficient for the commerce of the country.

"There will be other and more serious objections to inclined planes, besides those which present themselves on the first opening of these new communications between town and town; for, as the system becomes general, it will be found that the derangement of any of the multifarious machinery belonging to stationary steam engines, (which will occur at times, in the same manner as in all works of a similar nature,) would have the consequence of extending its effect throughout the whole line of communication with which they may be connected. As

far as the transport of merchandise may be impeded, the evil would only be the same as is now commonly suffered from canals; but when the conveyance of passengers or correspondence shall be taken into consideration, the objections to inclined planes became strong, if not insuperable.

"A multiplicity of machinery is the great evil to be avoided; and experience teaches us, that the daily expense may be diminished in proportion as our power is simplified and concentrated."

It follows from what we have stated of the dates of Mr. Gray's speculations, that we must have been somewhat in error in stating, as we did in our 325th number, that it was the *Scotsman* newspaper which "had the honour, four years ago, of *first* bringing forcibly under public notice the advantages derivable from locomotive carriages on railways." But while we frankly admit that in making this statement we overlooked the prior claims of Mr. Gray, we presume it will not be disputed, even by Mr. Gray himself, that it was the papers in the *Scotsman* which *first* made that desirable impression on the public mind which Mr. Gray's labours were intended, but had not the good fortune to produce. The reason of this it is not difficult to trace. Mr. Gray's writings on the subject have been mostly of too vague a cast, made up of statements which, though correct in the main, have not been sufficiently proved, and of conclusions rather in the nature of plausible guess-work than of verifiable calculation. The papers in the *Scotsman*, on the contrary, embraced the whole pith and marrow of the subject; were very circumstantial, distinct, and clear; calculated for popular comprehension, and yet so grounded in scientific principles as to command the assent of the most learned and profound.

MANUFACTURING CLOTH FROM WOOL, BY FELTING, WITHOUT SPINNING OR WEAVING.

Numerous attempts are now making in the United States to manufacture woollen cloth by felting, in the manner of hats, without either spinning or weaving. In the latest list of American patents we observe no less than five for this purpose; and *large sums* are said to have been already invested by our Trans-Atlantic friends in this sort of manufacture.

One of the most enthusiastic, and we believe the earliest of these patentees, a Mr. Wm. Harrington, of New York, thus expresses himself on the subject:—

"I do not claim as my invention any one of the machines used in the herein-described method of manufacturing woollen cloth, nor any particular part of any one of the machines; but I claim that I am *the first person* who by passing sheep's wool through the above-described or similar operations, and by a combination of the above-described or similar machinery, has been able *successfully* to manufacture woollen-cloth of sufficient firmness of texture, strength, and durability, to answer the valuable purposes named in this specification, (viz. carpeting, floor-cloths, rugs, table-covers, blankets, padding, &c.) without spinning or weaving, upon the principles of felting. The subscriber is not aware that any one has heretofore been able *successfully* to avail himself of the well-known felting properties of sheep's-wool for the purpose of manufacturing cloth suitable for carpeting, and other valuable purposes named in the specification."

Mr. Raymond, of New York, another of these patentees, affirms that by his plan of operation "cloth may be made of any desirable length and width, and suitable for carpets, blankets, rugs, *gentlemen's wear*, and other purposes, in greater perfection, with more dispatch and less expense, than by any other method."

Confident as these statements are, we apprehend they will be found very delusive. The notion of manufacturing cloth by felting is but a revival of an English project, long since tried and exploded. About forty years ago it was made a fair trial of by several English manufacturers, but eventually abandoned by all of them, because the cloth made in this way was much inferior to what the loom produced. Neither do we see any thing in the modes proposed to be adopted by the American patentees, which should lead us to anticipate that their efforts will be at-

tended with any better result. It is not, in truth, in the nature of things, that felted cloth should ever be of so firm and durable a texture as that which is spun and wove.

COMPARATIVE EFFECTS OF BLOWING HOT AND COLD AIR INTO FURNACES.

We took notice in our 308th Number, p. 336, of certain experiments of a Mr. Nelson, of Glasgow, which were said to establish the great economy of blowing hot instead of cold air into a furnace; and we then expressed an opinion, to the effect that the expense of making the air *hot* in the first instance would be found exactly to balance the subsequent gain. We now extract a farther statement on the subject from the *Glasgow Chronicle*, which is very much at variance with this opinion. Facts are stubborn things certainly, but we must confess that we are still at a loss to discover the *sufficient reason* which governs the present case.

"Since we last noticed the application of heated air to blast furnaces, experiments with it have been steadily persevered in at Clyde Iron Works, and the result is highly satisfactory. It is completely ascertained by these experiments that iron is smelted by heated air with three-fourths of the quantity of coals required, when cold air, that is, air not artificially heated, is employed for that purpose, while the produce of the furnace in iron is, at the same time, greatly increased. All the furnaces at Clyde Iron Works are now blown with it. At these works the air, before it is thrown into the blast-furnaces, is heated to 220 deg. Fahrenheit, in cast-iron vessels placed on furnaces, similar to those of steam-engine boilers. It is expected that a higher temperature than 220 deg. will be productive of a proportionally increased effect. But this is still the subject of experiment. It is calculated that this improvement will accomplish a saving in the cost of the iron smelted in Great Britain to the amount of, at least, 200,000*l.* a-year. The fact that heated air is better adapted than cold air to promote combustion is now incontestably established by experiment. No argument to the contrary is afforded by what is also the fact, that a fire burns better in cold than in warm weather. The fire burns better in the former than in the latter case, not because the air is cold, but because it is dry. Let cold air be artificially heated, and its superiority in promoting combustion over air naturally of the same temperature, but not artificially heated, will be apparent. It has been attempted to account for this fact in various ways. The most simple theory seems to be, that air is not fitted to promote combustion till it reach a high temperature, and that a quantity of fuel is expended in raising it to this temperature before it can be of any use in promoting combustion. The question, therefore, so far as concerns the saving of fuel, in the smelting of iron, resolves itself into this—whether it is most economical, in respect of fuel, to heat the air in the smelting-furnace, where it comes into contact with the coke, and carries it off in the form of carbonic acid gas, or to heat it previously in a separate furnace. The experiments at Clyde Iron Works show that it is heated in the separate furnace with one-eleventh part of the fuel that is required to heat it in the smelting-furnace, when allowed to come in contact with the coke. One reason why that should be the case is very obvious: in the smelting-furnace the air is heated with coke, in the separate furnace with coals. These observations do not apply to the mode of heating the air in a close vessel, by means of the smelting-furnace itself, before it is allowed to come in contact with the coke. The experiments with respect to this mode of heating air are still in progress."

Enquiry.

Sir,—Do me the favour to insert the following query; and if any of your readers will answer it in the course of *next week* (as I am going to Valparaiso early in January), I shall feel greatly obliged.

I am, Sir, your obedient servant,

AQUEDUCT.

Upper Clapton, Dec. 29, 1829.

If a leaden pipe half an inch diameter in the bore were filled with water, and laid in a straight horizontal line from a reservoir whereof the level of the surface is 30 feet above the discharging orifice of the pipe, *with what velocity* would the fluid issue from the pipe at the distance of 20 miles from the reservoir? And with what *velocity* at half the distance? And at three-fourths of the distance? Also at ten times the distance, viz. 200 miles?

MINOR CORRESPONDENCE.

Jackson's Studs for Boots and Shoes.—We have forwarded the letters of Mr. B. Foster and Mr. William Hardcastle, bearing testimony to the merits of these studs, to the patentee, and must decline inserting any more letters on the subject, except by way of advertisement on our monthly covers. It must suffice to say on our own parts, once for all, that we think the invention a very excellent one, and deserving the patronage of all, to whom a sound, durable, and comfortable-wearing boot or shoe is an object.

Callet's Tables.—Mr. Utting requests us to point out the following erratum in Callet's Table of the Logarithms of Sines and Tangents, intended to accompany Mr. Babbage's Table of Logarithms:

In the log. tang. of 24′ 54″, for 7·8599851, read 7·8599331.

A Case for Mr. Hebert.—Sir, M. Peclet relates, that a few days after the steam-boiler, designed to heat the Exchange in Paris, was brought into use, it was perceived that there was a hole in the bottom of it. The fire was extinguished, and it was found on emptying the boiler that the metal was burnt in a place where a piece of rag had been deposited, but overlooked when the boiler was filled with water. Now, I should like to know from Mr. Hebert, to what cause he would ascribe the failure of the boiler in this case? Will he tell us that this all comes from heating by steam? Surely not; and yet there would be no more absurdity in his blaming the heat instead of the rag in this case, than there was in his ascribing the accident which befel "The Novelty," to the bellows instead of the feed-pump.

I am, Sir, &c.
Q. IN THE CORNER.

A Remonstrance.—Sir, You are pleased in your review of "The British Almanac for 1830," (see *Mechanics' Magazine*, No. 328, p. 216,) to say that the compilers "have ventured this year, with the help of a pair of globes, and of such other lights as are *common to the sphere of seminaries for young ladies and gentlemen*, to give on their own authority the positions of the principal stars and planets for each month." I must be allowed, Sir, as one of the class to whom you make this not very liberal allusion, to observe that you do them great injustice by the comparison. The "lights" common to our sphere may be not very brilliant, but they are at least considerable enough to prevent the least informed amongst us from committing such astronomical blunders as are *common* to "The British." No preceptress who teaches the use of the globes would have thought of *selecting*, as the compilers of that almanac have done, an hour for observation when it seldom happens that more than one of the planets are in sight; or could possibly have descended to the quackery about the Right Ascension with which each left-hand page of the calendar commences (for, taken in connexion with problems on the globes, very clumsily solved, it is in truth gross quackery); neither would such a person (I guess) have thought of inserting the Table of the Sun's Parallax, given at p. 6, from its utter unfitness for the place, than she would have thought of introducing directions for pickling cucumbers. Pray, Mr. Editor, let it be known in some way or other, that there is nobody, even in "the sphere of seminaries for young ladies and gentlemen," who would not be ashamed of such things; and oblige your constant reader and fervent admirer,

A GOVERNESS.

Clapham, Dec. 23, 1829.

MISCELLANEOUS.

Large Still.—The largest condenser for distilling gin ever manufactured has just been made for Mr. Hodges, by Mr. Joseph Hulls, of High Wickham. Its height is 14 feet 6 inches; its dimensions 8 feet. It is calculated that it will distil 10 gallons per minute, 6000 per day, or 1,878,000 per annum.—*Morning Herald.* The productive capacity of this still is by no means so unrivalled as represented. In many Scottish distilleries, where alembics are employed from 52 to 54 inches in diameter and about 8 in depth, no less than *eighty gallons* are produced every three minutes and a half.

Economic Lighting.—At the Tulloch, Bleachfield, a young man, named A. Reed, has constructed an apparatus by means of which he is enabled to procure from the wood which they are in the practice of burning in order to obtain acetic acid gas, sufficient to light the whole premises. By this ingenious device a most important saving is effected, since no more wood is necessary for both the gas and the acid than was formerly used for the acid alone.—*Glasgow Chronicle.*

INTERIM NOTICES.

We are constantly receiving so many letters from individuals containing mere announcements of inventions, without any description of them, and having generally for their sole object to bring them under the notice of persons who may purchase or take a share in them—communications which are in fact purely commercial, and which, if inserted, would subject us to the advertisement duty—that we feel under the necessity of laying it down as a rule, that all letters of this description can only be inserted as advertisements on our monthly covers, and must be paid for as such.

S. P. W. is requested to send to our office for a note addressed to him.

Communications received from C. H.—J. T. H—e—G. W. J.—Mr. Baverstock—E. S. L—T.—M. J.—Mr. Butterworth—Clyde—A Joiner—A Berkshire Mechanic.

Errata in a few of the Copies of last Number.

Page 307, column 1, line 20, for 'Vanloue,' read 'Vauloue.'

P. 310, col. 1, line 28-29, for 'annalyst,' read 'analyst.'

P. 310, col. 1, line 40, for 'slip,' read 'skip.'

P. 310, col. 1, line 46-47, for 'he cannot bring any one of his modifications to accord with,' read 'he cannot bring more than one of his modifications to an obvious comparison with.'

P. 310, col. 2, line 33, for 'varies,' read 'so varies.'

P. 310, col. 2, line 43, for 'verily,' read 'verify.'

P. 311, col. 1, line 16, after 'distances,' add 'declinations.'

P. 312, col. 1, line 15 from the bottom, for 'practical,' read 'physical.'

P. 312, col. 1, line 10 from the bottom, for '$m'P\,3$' read '$m\,P\,3$'

$m'P'3'$ $m'P'3.'$

P. 319, col. 2, line 8 from the bottom, for 'geometric,' read 'geocentric.'

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M. SALMON, Printer, Fleet-street.

Mechanics' Magazine,

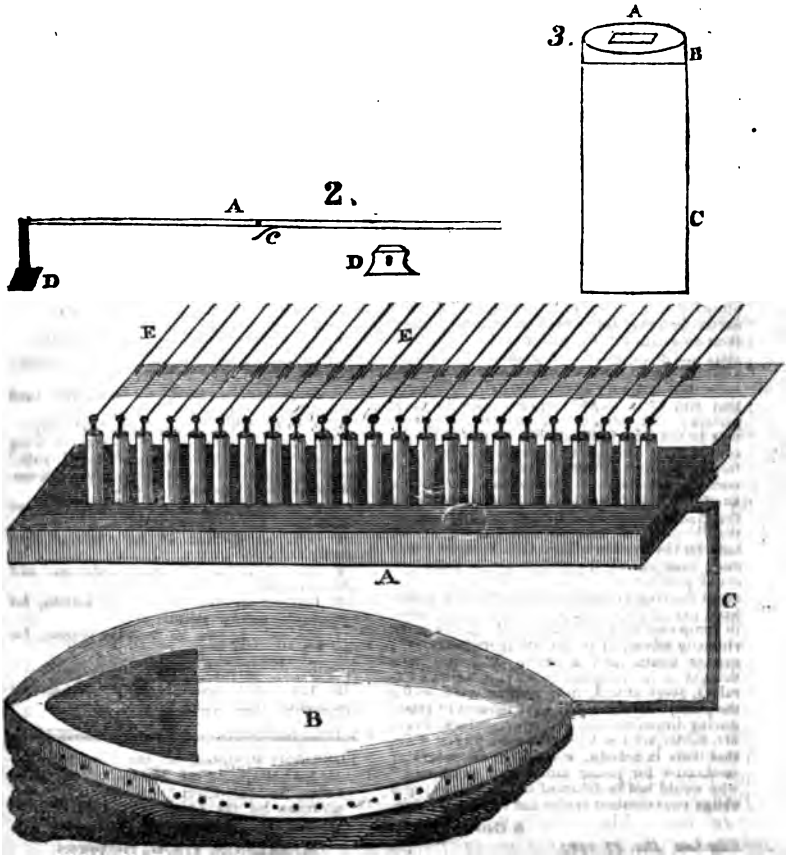
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 335.] SATURDAY, JANUARY 9, 1830. [Price 3*d*.

" O mortal man! who livest here by toil,
Do not complain of this thy hard estate;
That, like an emmet, thou must ever moil,
Is a sad sentence of an ancient date;
And certes, there is for it reason great:
For tho' sometimes it makes thee weep and wail,
And curse thy star, and early drudge and late,
Withouten that would come an heavier bale,
Loose life, unruly passions, and diseases pale."

CASTLE OF INDOLENCE.

PLAN OF AN HARMONICON.



PLAN OF AN HARMONICON.

Sir,—I beg leave to submit the following plan, for the construction of an harmonicon, to the consideration of your numerous readers and correspondents.

I am, Sir, with respect,
C. B———k.

Description.

Fig. 1. A is an air tight box, which is supplied with air through the pipe C from the bellows B: on the top of the box are inserted the small pipes DDDD, having each of them at the top an harmonicon with only one tongue each (of course the harmonica must be modulated as a piano-forte). When the notes are to be produced the keys E E E must be depressed, which allow the air to pass through the harmonica. I have drawn on a larger scale, fig. 2, one of the keys which must act as those of a flute. A is the key; D a stop, covered with wash-leather to prevent the harmonica from vibrating; C a spring which must be made strong enough to prevent the air from raising the stop when the box is filled with air; B a small block in which the key is inserted, and confined by a pin passing through them both. Fig. 3, represents also, on a larger scale, the harmonicon. A is the harmonicon, which for convenience ought to screw off the cylinder C at B.

N. B.—The ends of the keys terminate like those of a piano-forte; in fact, the exterior is exactly like one.

ON THE REMOVAL OF DEPOSITS OF EARTH IN TIDAL RIVERS, AND THE PROBABLE EFFECTS OF REMOVING THE OLD LONDON BRIDGE. BY O. C. F.

Sir,—The subject of the tides, upon which you have lately been saying so much, and with such comprehensive and scientific views, is one to which you cannot too frequently invite the attention of the inhabitants of the metropolis, and the proprietors of estates on both sides of the Thames, for four or six miles above London Bridge.

In your able examination of the *merits of* different almanacs (No. 329, p. 232), after specifying the difference between the times of high-water immediately above and below London Bridge, you ask, "Is there not great reason to apprehend that when the old bridge is removed, a great alteration will be produced in all these respects?" There is, indeed, so *great* reason to apprehend that the alterations will be very important and serious, that I cannot but wonder the *thousands* who are deeply interested in the result, do not set themselves to inquire what will probably happen.

Mr. Smeaton (to whose valuable reports you refer in your exposure of the extraordinary blunders of Mr. Lubbock) in his letter to the Lord Mayor, Aldermen, &c., on the state of London Bridge, dated 23rd June, 1767,* speaks thus—

"It is difficult at this time to determine whether the bed of the River Thames was as high above London Bridge before London Bridge was first erected, as it now is; and whether the stoppage of the water at the bridge, acting as a dam, was an *expedient* to retain more water in the river at low water over those shoals for the sake of navigation; or, whether this stoppage arising from the obstruction has, in its *effects*, occasioned the sullage of the river gradually to gather, and the bed to rise nearly in the same proportion as the water's surface at low-water is kept higher? However this might be, 'tis certain the bed of the river above bridge is now, *in proportion, higher* than it is below bridge.

"If London Bridge were, therefore, to be taken away, *the river would become so shallow above bridge at low-water, that the navigation would be greatly impeded* FOR HOURS *each tide!*"

Residing near London, and being personally concerned in the general question, I often attended the Committees of the House of Commons on London Bridge, in 1822, and well remember the substance of the evidence given by several scientific men on that occasion. Amongst others to whom I listened, the sentiments of Dr. Gregory, of the Royal Military Academy, completely accorded with

* Smeaton's Reports, vol. ii. p. 23.

those of Smeaton just quoted. He said he was decidedly of opinion that, after the removal of the old bridge, the bed of the river between its site and Westminster Bridge would often, at and near low-water be dry, and the navigation completely at a stand. On being asked if he could suggest any remedy for so great an evil, he replied there was an obvious and effectual remedy which he trusted would be adopted. His proposal, if I correctly understood him, was to the following effect:—

That the new bridge, instead of having five arches, as was proposed, should have *seven*; and that under each arch there should be sluice-gates of a kind into the minutiæ of which I cannot enter, but which, he said, were well known in Holland—that there should be similar sluice-gates at Westminster Bridge, and perhaps at Blackfriars Bridge; the whole of the river between London and Westminster Bridges being thus converted into a large wet-dock—that the river should be contracted by extending the wharfs and quays farther upon the present bed, both on the Surry and the Middlesex sides*—that in these operations all sudden projections and bold sinuosities in the river should, as far as possible, be softened down—that by the judicious shutting and opening of some, or of all, of the sluice-gates at the three bridges, and by the employment of temporary aprons or water-turners, so as to direct the stream upon deposits of mud, &c., under the constant superintendence of proper officers appointed by the Conservators of the Thames, the evils which would otherwise inevitably result from taking down the old bridge might be greatly diminished, if not altogether prevented, and the navigation above bridge considerably improved.

I well remember hearing Mr. Telford (who was then employed by the City of London to oppose the new bridge) say to Dr. Gregory, as he quitted the committee-room, "If they adopt your hints, I shall advise the City to withdraw their opposition." The plan, however, has not been adopted; and the erection of a bridge of five instead of seven arches will evidently render it more difficult of execution. But I am one of those who think that unless *some such* plan be carried into operation, a very few years will transfer all the business now done at wharfs above bridge to widely-different localities.

Yet, Sir, I am no croaker; and rather mean, by the previous detail, as well as what follows, to suggest what is useful than to indulge in dismal forebodings. I shall, therefore, with your permission, employ the remainder of this communication in briefly describing the nature and use of the aprons and water-turners alluded to in Dr. Gregory's evidence.

(To be concluded in our next.)

* This proposal was, if I rightly recollect, several months *before* the announcement of Col. *French's plan.*

IMPROVED STEAM-BOAT PADDLE IN ACTUAL USE.

In the last Number of "The Register of Arts," there is a letter from a Mr. Merryweather, of Lincoln Castle, containing an account of an improved paddle-wheel, which is stated to have been recently invented by a smith of that place of the name of Poole, and adopted with great advantage in the steam-vessels navigating the River Witham. The Editor of the "Register" introduces the letter of his correspondent by congratulating "the public that an apparatus has been *at length* not merely devised, but brought extensively into actual and beneficial operation, by which the inconvenience and waste of power attending the use of the common paddle-wheel are completely obviated." And the correspondent himself observes—"Having paid *very particular attention to whatever has appeared on that head*, I think I may venture to say, that to this time there are none that have answered the expectations entertained of them, nor is there one in actual and beneficial practice; a sufficient proof of the entire failure *up to this period.*"

That none of the many other "improved" paddle-wheels which have of late years been brought under public notice has yet been brought into

"actual and beneficial practice," is, we believe, quite true; but that this is "a sufficient proof of the (their) entire failure," is, we presume to think, rather a hasty conclusion. Can a thing be said to have *entirely failed*, that has never been *fairly tried?* Or to have failed at all, that has never been tried at all? We have heard of various experiments with new paddle-wheels, and have recorded some which furnished very promising results; but we question much whether any of them—even those which seemed most likely to succeed—have as yet had a *fair trial*; such a trial, for instance, as it has been the good fortune of Mr. Poole to obtain. We know too of some very ingenious schemes of wheels which have but existed on paper or in models, and to which, of course, Mr. Merryweather's "sufficient proof" cannot possibly have any application.

There is a case of the latter description, which we feel it to be our duty to submit very specially to Mr. Merryweather's consideration, that will at once convince him that a scheme may be extremely good, and yet pass unheeded even by such as flatter themselves that they "*have paid very particular attention to whatever has appeared*" on the subject. We refer to the design of a paddle-wheel, which he will find described by Chelmeriensis in our 276th Number (October, 1828), which was afterwards (No. 298, p. 173) stated to be the invention of Mr. Joel Lean, of Fishponds, near Bristol, and a model of which has been exhibited for several months past at our office. We invite Mr. Merryweather to compare the construction of that wheel with the construction of the wheel of his *protegée*, Mr. Poole, and to state in what material respect the one differs from the other. To us they appear to be substantially identical; but that our readers may be enabled to judge for themselves, we subjoin Mr. Merryweather's description of Mr. Poole's wheel, as it appears in the "Register." It is, of course, possible that in this, as in other cases, the two parties may have hit on the same invention, without the one being aware of the other's proceedings. Be this however as it may—be the wheel in question the invention of Mr. Lean or Mr. Poole—we join with the Editor of the "Register" in congratulating the public on its being adopted with such beneficial effect as the following letter describes:—

"The object of this communication is chiefly to introduce to your notice, and thereby to the public, another candidate for an improved paddle-wheel, in a Mr. Poole, a smith of this town, who is possessed of considerable mechanical invention, and is also a superior operative, and to whom I have frequently made known whatever has been offered to the public on this subject, either in models, or attempts in practice. Mr. Poole has recently patented his invention, and I believe it will be found to surpass every other of the same kind hitherto offered to the public. The wheel is a common one, to be suited to the size of the vessel it may be designed for, except that the float or paddle is not fixed to the radii, but vibrates on its axis in the rims of the wheel. On the side of the vessel is placed, *very securely*, two concentric circles of iron, placed vertically edgeways, with a space of about one inch and a half between them, forming thereby, what may be called a railroad, on the side of the vessel for a guide-pin, fixed on the end of a lever, attached to the paddle-axle to travel in. The concentric circles before-mentioned are placed *excentric* to the axle of the wheel, and the paddles are thereby carried round, so as to enter and leave the water in such angles as to avoid the splash at entering and the lift at coming out. This wheel allows advantageously of a deeper immersion in the water than the radial paddle, obtaining a greater power by being brought to a leverage on a denser medium than the surface water, and thereby adding most materially to the propelling power of the wheel: it is equally efficacious in its back stroke. It should seem however that one-third of the diameter of the wheel, from present experience, is the best dip; and as this may allow of the lowering of the main axle, and probably the reducing of the wheel, in consequence of the greater extent of paddle surface that can be employed, the paddle-boxes may be considerably lowered. The angle formed by Mr. Poole's arrangement, we know, has been obtained before by Mr. Steenstrup, Mr. Oldham, and others; but it has hitherto been the result of intricate trains of wheels, endless chains, &c. &c.: the expense of making which, the loss by friction, the

liability to injury, and the difficulty of reparation in complex machinery, are very sufficient reasons why their inventions have not been carried into practice. The same beneficial angle, however, is got by Mr. Poole's excentric railroad, and is obtained by a mere lever connecting the paddle-axis and the railroad, which is traversed as the wheel is driven round by a guide-pin at right angles to the end of the lever; and to prevent the noise, which was found to proceed from friction-wheels, pieces of thick sole leather, cut round with a hole in the centre, are kept upon the guide-pin, and screwed together upon it so tight and hard as to bear the friction of the railroad circles, without injury, for a great length of time, and which quickly assume a hardness and polish with use that will almost defy wear. I am well aware that models are very fallacious, and that they have often deceived the most knowing mechanics when put into practice: I am therefore most happy in being enabled to show the effects of Mr. Poole's wheels in practice, as they have been placed in succession on three different steam-packets, that are regularly plying between Lincoln and Boston, a distance of more than 31 miles, on one of them for a period of five months; the particulars of which, with the size of the boats, &c., are given below, and the new wheels are certainly effecting much more than has hitherto been obtained by any other; and when they can be used with a different description of boat, in which the condensing-engines must give way to the superior high-pressure engines, and patent tube-boilers of Mr. W. H. James, (which I have had the pleasure of seeing on board their "Safety Steam-Boat," at Vauxhall, and which I believe to be *decidedly superior* to any other hitherto offered to the public, both for *security against accident*, as well as *lightness with power*,) many of the objections at present existing against the introduction of steam navigation on rivers and canals must be removed. This being a subject in which I am much interested, being one of the Committee of Management of the River Witham, who are most anxious to give every facility in their power to steam-vessels navigating the Witham, though they are compelled from the present structure of the vessels to limit the rate of speed to 4½ miles per hour in the first nine miles from Lincoln, for fear of injury to the banks, in consequence of the reduced scale of that part of the river.

Description of Steam-Vessels navigating the River Witham.

Names of Packets, and when Poole's New Wheels were attached thereto.	Length of Keel.	Width of Beam.	Horses' Power of Engine.	Draught of Water when light.	Dead Weight of Engine, Machinery, Boiler, and Water therein.	Average Speed with Old Paddles.	Average Speed with New Paddles.	Consumption of Coals with Old Paddles.	Consumption of Coals with New Paddles.
	Ft.	Ft.		Ft. In	Tons.	Miles	Miles	Bush.	Bush.
Favorite, July 27, 1829.	67	10½	8	2 8	9	5	6	40	32
Countess of Warwick, Sep. 22.	68	10	10	3 3	11	5	6	40	32
The Witham, Dec. 6.	74	12	9	3 3	13	4½	5½	48	40

"N. B.—The average speed in the above table must not be looked upon as what *only* can be accomplished, the *limit of speed* before mentioned being the occasion of it. In the lower part of the river, where the width is from 90 to 100 feet at surface, and 7 feet to 10 deep, the *Countess of Warwick* can go *eight miles* per hour well *on still water*. The *Witham*, when put down by loading to four feet, which she has been, goes surprisingly better; thereby showing *the advantage derived* by a deeper leverage. The consumption of coals stated, is in going down to Boston one day, and returning the next."

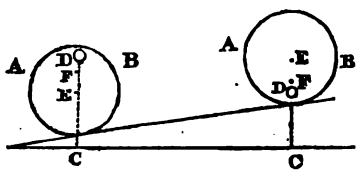
NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

(Continued from page 319.)

There are some experiments which may be shown, by which the centre of gravity may seem actually to as-

cend rather than descend. It is a general idea, that the centre of gravity lies in the centre of magnitude; and this is true, when the body is composed of the same substance throughout. But let ABC be a circle of any

Fig. 1.

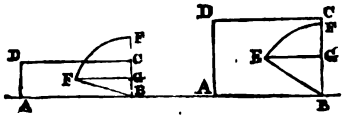


light substance, as wood, &c.; and let there be part of it, as a hole D, filled with lead. Now the centre of gravity has been moved to F, in consequence of the weight D being applied, while the centre of magnitude is at E, the centre of the circle. If the body be so placed that the centre of gravity be above the centre of magnitude (or rather a little to one side), it will roll towards that side, even although the plane on which it rolls be so inclined as to form a slight ascent. Yet, notwithstanding that the centre of gravity may *appear* to ascend, yet in reality it descends, as may be thus proved. Measure the height of the centre of gravity from the horizontal line CC, also its height when it shall have arrived at the top of the plane; at which place it will be found to be lower than it was at first, although the centre of magnitude is higher.

The centre of gravity is not always a real point in a body: thus that of a ring is at an imaginary point, as is also that of an arch.

When a body which rests upon a base is liable to disturbance, its stability depends upon the position of the centre of gravity. Let ABCD be a

Fig. 2. Fig. 3.



parallelogram, the centre of gravity of which is at E: draw the line FB, and, with B as a centre and radius BF, *describe the* arc EF: draw FB *perpendicular*, and EG parallel to the horizon. Now to turn this body over on the point B, it is evident that the centre of gravity must be moved from E, along EF, or, what is the same thing, must be raised the height of GF. Again, let the body be twice the height, but on the same base: let ABCD be the figure, (see fig. 3.) draw lines in the same manner as the last, when it will be seen that the line GF is shorter than in the last case; consequently it will be more liable to turn over. It may be shown in exactly the same way, why waggons, &c. are more dangerous when the load is placed high than when it is lower.

It is also on this principle that the stability of the different positions of the human body depends: the degree in which it exists may be determined by drawing lines joining the toes and heels of the feet. Thus, it is evident

Fig. 4.

that great stability is obtained in a sideways or lateral direction, while there is very little in the opposite one. In the next there is quite the opposite

Fig. 5.

effect obtained, for there the greatest stability is obtained in a front direction. Different effects are obtained in the two next figures, which will be easily understood.

Fig. 6.

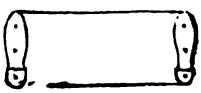
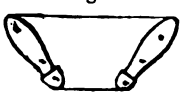


Fig. 7.

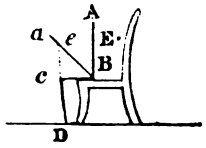


All the various inflections of the body are governed by this principle. But there are some curious instances of the effects produced, which may be amusing.

When a person is sitting on a chair,

if he attempts to get up, he will find it impossible, if he keeps his body erect; but if he stoops forward, he can easily do so, which may be thus explained. Let A B represent the

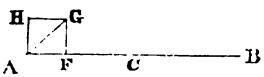
Fig. 8.



body, B C the upper, and C D the lower parts of the legs of a person when seated. Now the centre of gravity being at E, it is plain that there is no support for it except the stool; but when he throws his body forward in the direction B*a*, then the centre of gravity, *e*, is above his feet; consequently, the only force required will be in a perpendicular direction.

It may have been observed, that when a man, a horse, &c. is turning a corner, the body is inclined towards that corner. This is most visible in the feats of horsemanship effected in a ring. Let AB represent the diame-

Fig. 9.



ter of a ring, round which the horse is to run, and the centre of which is at C. Now when a body is turning round rapidly, there is a certain force generated which is called a centrifugal force; the effect of which is to make the body endeavour to fly away from the centre. Let the line G H be the direction and quantity of that force, then the line of direction of the centre of gravity will be in the line HA. Now by making a parallelogram on the lines G H and G F (G F being substituted for HA), the diagonal GA will be the resultent, and which is the direction of the horse's body.

The same effect is observable in a carriage; which shows the danger of turning a corner rapidly, particularly when the weight is placed high.

A rope-dancer uses a pole, by means of which he shifts the centre of gravity from one side to another, according as he finds himself leaning on the opposite side.

(To be continued.)

PURIFYING OIL—BRIGHT'S SHADOWLESS LAMP.

Sir,—I am inclined to think that purifying oil by filtration through charcoal, (respecting which "A West Countryman" makes inquiry in your 329th Number, p. 254,) is the French method of extracting humid particles from the "huile de colse," after being agitated with sulphuric acid, which is used in purifying it for burning; but our oil used for illumination, which is almost entirely obtained from fish, is not so treated, and would, I presume, not be benefited by a similar remedy. Should your Correspondent have faith in the advantage of filtering through charcoal, he can easily try so very simple a process. He should have stated what sort of oil his is; and if it has been frozen for merely a twelvemonth's keep, would not so deteriorate it as he mentions. Considering the immense consumption of the better sorts of lamp oil, it is extraordinary we know so little about chemicising it. The French certainly have the start of us in the preparation of their seed-oils.

Bright's lamp is on the principle of Hero's fountain: though all hitherto made on that plan have been so constructed, that when a leak occurred, it was very uncertain if it could be stopped, on account of the number of tubes and chambers enclosed by one case. The pneumatic lamp, a French and most ingenious application of Hero's principle, was formerly very generally used both here and on the Continent, and when properly manufactured succeeded admirably; but it was often impossible to repair it. In Bright's lamp the reservoirs are only connected by tubes, and there are fewer of them than in the old lamps—consequently they are easily repaired. I know of one having been used for more than a year, which still acts perfectly well.

Your obedient servant,

Q. A.

December 9, 1829.

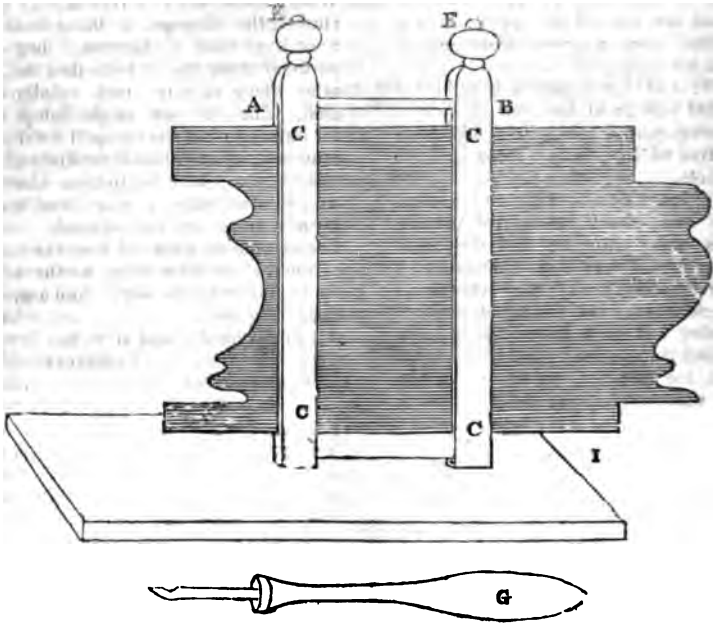
INSTRUMENT FOR TAKING THE PATTERNS OF MOULDINGS, VASES, &c.

Sir,—Having noticed, in the 115th Number of your highly useful publication, a sketch of the rough model of an instrument for taking the shape and pattern of a moulding, vase, &c.; and thinking with the original inventor that, if improved upon, it might be of considerable use to the carpenter or the turner; I herewith send you a drawing of one I have had constructed upon an improved plan, which, if you think deserving, you will oblige a constant reader by inserting in an early Number.

I am, Sir,

Your obedient servant,

AN AMATEUR TURNER.



Description.

A and B are two upright pieces of brass, or wood faced with brass, through the centre of each of which, and between the letters CCCC, a longitudinal cut is made, sufficient to admit to the number of one hundred steel wires (size No. 17, or smaller if required,) to pass freely. EE are two iron finger screws, inserted in the tops of the upright pieces A and B, and passing a little way into the longitudinal cuts at CC; by means of which the wires are tightened or secured when the pattern to be taken is finally adjusted. I is a slab of wood, into the surface of which the lower ends *of the upright* pieces are inserted when the pattern of a vase, or any other moveable article, is required to be taken. G is a small instrument for advancing each wire forwards separately.

N. B.—The wires, if cut precisely of the same length, will delineate the required pattern, both convexly and invexly, with the greatest possible accuracy.

LEESON'S PATENT SAFETY SPRING LOCK.

Sir,—The liberality you have always evinced in your ably-edited work, the "Mechanics' Magazine," convinces me that apology is quite un-

necessary in soliciting your notice of an invention, which I trust will be as beneficial to the patentee as it will be useful to the public, and in some cases aid the cause of humanity; for, by the simplicity of Mr. Leeson's "patent safety spring hook," a horse that should happen to fall down under a stage, gig, or carriage, can be instantly released from such a distressing situation. This I think of some importance; as, in nine cases out of ten, the animal (particularly a spirited one) receives more injury from his struggling than from the fall itself; and the accident is often attended with great danger to the driver, passengers, and any persons who from motives of humanity volunteer their services.

At first, Messrs. Taft and Leeson took out their patent for driving reins only, thinking that the timid driver would feel more confidence in their "spring hook," than the usual dependence on the tongue of a small buckle; but subsequently they have applied it to various parts of harness: such, for instance, as the tug of the loop that supports the shafts (often so much curved as to render it difficult and even dangerous for *one* man to harness or unharness a spirited horse). By this simple contrivance expedition and security are at once obtained, and the general appearance of the harness rendered much neater. It is also applicable to traces, pole-pins, coupling rings, &c.; and will be found very useful to mail and stage contractors, as much time is thus saved in attaching the horses to a vehicle.

Having thus disposed of this invention as applicable to harness, I beg leave to point out one or two other instances where it may prove equally useful. The fair sex might adopt the "safety spring steel loop" for the greater security of valuable necklaces, bracelets, &c.; and gentlemen who carry valuable watches, would find it admirably suited for *watch-guards*.

I send you drawings of the invention, should you deem them worthy a place in your valuable work; and am, with great respect,

Sir, your obedient servant,

T. REILLY.

15, *Finsbury-place*,
Dec. 18, 1829.

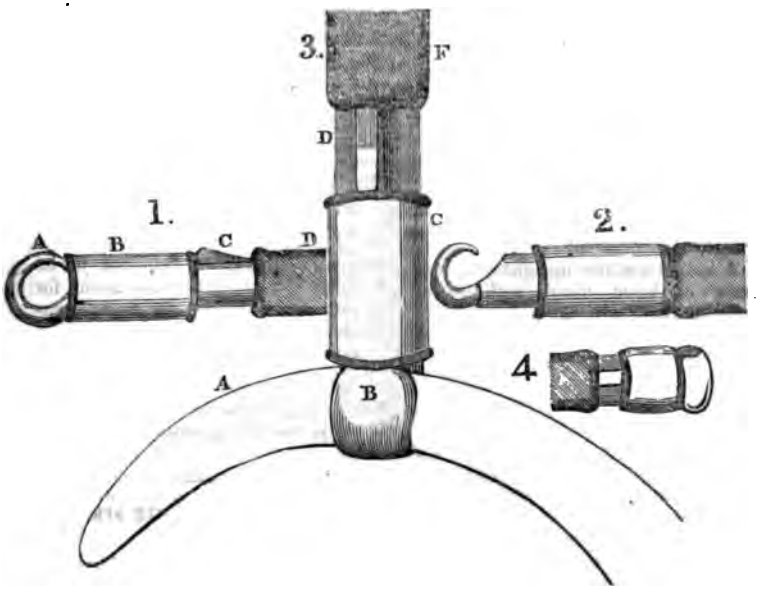


Fig. 1. A the hook; B the sliding-tube; C the *spring-catch* to prevent the slide from coming back; D the rim.

Fig. 2 shows the slide-tube drawn back.

Fig. 3. A the shaft of a gig; B the hook, or tug, to receive the shaft; C the safety slide-tube; D the spring-catch; F the back-band.

WINANS' PATENT WHEEL.

Since we last took notice of this wheel, (p. 211.) Mr. Winans has enrolled his English specification; which does not, we find, differ in any material respect from the one he had previously lodged in the Patent-office at Washington. We shall in preference, however, to giving either specification, now lay before our readers the description of the wheel given by Mr. Winans' American partner, Mr. Sullivan, in the "Journal of the Franklin Institute," (No. for April, 1829,) because, in the first place, it is shorter; and, secondly, because it is to this description the very able report, which we also subjoin, by the Committee of Mechanics of the Franklin Institute, on the merits of the invention, bears reference.

Mr. Sullivan's Description.

The wheels of common cariages operate as levers of the second class, because the wheel turns on the axle, but when the axle turns with the wheels, it operates as of the first class, or as a windlass.

The main travelling wheels of Mr. Winans' carriage are of the latter kind. The fixed axles pass through the wheels, and extend about nine inches from them; the last three inches thereof being converted into smooth gudgeons. These enter under the upper part of the rims of the *secondary wheels*, (those of the second class of the lever,) which, in this modification, are placed outside the large wheels, but do not touch the ground, and are about half their diameter. They have short axles each, which apply in brasses under the double side pieces of the frame, between which they are lodged. Their rims hanging on the gudgeons, their short axles bear up the load frame, and when the primary wheels roll forward on the railroad, their axles turn, and the gudgeons roll in, on and under the smooth surface of the rim of these outside wheels, which of course revolve *slowly, and* turn perhaps once, while *the large* wheels and axle turn ten times; the bearing or rubbing axles moving thus very slowly, perhaps no attainable speed of the carriage would cause them to heat.

This form of the cariage thus requires no fixtures; but the essential parts are combined naturally together, and work without any liability to separate. Nor is there any friction but that of the small axles, which it is the object of the leverage to overcome.

Thus the compound leverage of this carriage conquers the resistance of friction, and allows of augmenting the quantity of load. The horse carries the instrument of his power as a part of his burden. His speed, like that of a steam-engine, would accelerate till the force and the resistance balance each other, or steadiness is attained.

There are sundry incidental advantages, besides, in this form of the carriage. In passing along curves, the outer wheels will turn as much on their axles as the outer line is longer than the inner line of the track, instead of slipping thus much. They will yield to this resistance; but ordinarily the weight of the load alone fixes the axis in the naves, because they meet with more resistance there than at the gudgeons.

In turning curves of the road, the manner in which the gudgeons are lodged, capable of a little retrocession, allows the flanch which touches the rail to turn off from it. The flanches are, therefore, on the outside the wheel; and even in great velocity, it cannot gain upon the rail, because it must be turned off with force equal to that with which it acts.

To enable this railway-carriage to go temporarily on streets, I make the secondary wheels of greater diameter, so that they may reach below the primary wheels and below the level of the rail. When the carriage arrives at the end of the road, *the pavement being there raised to its level, nearly, the secondary wheels take the ground and bear the load.* The main wheels being thus relieved, their axles fall a few inches into scores in blocks, placed on the side frames to receive them. They are thus suspended from use, but remaining in place, when the carriage returns to the railroad and enters thereon, they rise from their repose, and take the bearing of the new load.

But to enable the carriage conveniently to traverse streets, and be guided, I make the frame in two divisions, and connect them with the bottom of the load body frame by pivot bolts, &c. and

a tongue which shifts to either
But these frames, at re-
g on the way, are secured in

ther mode mentioned in my spe-
on of the improvement, of con-
this carriage to street use, is, to
o it a pair of trucks, on which
or screw is placed, whereby to
fore part of the waggon, and let
der part run on the hind second-
eels.

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of the Committee of Mechanics of the Franklin Institute.

committee beg leave to report:—

they have attentively considered
ject assigned to them, both with
ce to the model before them,
the description contained in the
l of the Institute. They have,
e, duly weighed the remarks of
ullivan, contained in a letter
accompanied the model, and
nvited the closest scrutiny into
rits and defects of the principles
struction, and of the mode in
it is proposed to apply them to
e.

resistances to be overcome in
g a load over a common turn-
r other road, arise from several
, first, from the inequalities of
d itself, which allow the wheels
at one moment into cavities,
quire them, and of course the
io, at another, to rise over pro-
es. Secondly, from the *friction*
axles in the naves of their
Third, from the adhesion of
eels to the materials of the road.
, from the air in which the
and all connected with it must
placed. To these causes of
ce we may add that of the
of the carriage and its load when
acing its motion; and finally, the
ion of the plane of the road,
will be in concurrence with, or
sition to, the above-mentioned
according as the carriage is
ng or descending, and of course,
rizontal plane, is equal to zero.
mary object of all railroads is,
ner the first mentioned cause of
ce; namely, the inequalities of
To do this completely, the
ls composing the rails, and the
which pass over them, must be
hard, smooth, inflexible, and
the most minute particles of
matter. If this were practically,
as theoretically, characteristic
of the railway, there would be no question about the amount of the second resistance, because the wheels, instead of turning on their axles, would then slide on the rails without revolving at all, as they are sometimes observed to do upon very smooth ice; and this, too, however small, might be the friction at the naves of the wheels, because the friction at the periphery would be still less, that is, absolutely nothing. The car would, in fact, become a sledge. But since the imperfection of materials, and the unavoidable inaccuracy of all strictures formed by human art, forbid us to expect such a railway will ever exist, it becomes necessary to compute the amount of the second resistance, and, if possible, to devise means to reduce or to overcome it. The friction is reduced by making the nave and its axle as smooth as possible; by forming the two different metals; by reducing the diameter of the axle as far as may be consistent with proper strength; and finally, by the lubrification of the rubbing surfaces with such oily substances as are found effectual for this purpose. By these expedients, and by duly defending the interior of the naves from dust and from water, it is found that in practice the friction due to the axles may be reduced to about $\frac{1}{110}$ of the load.

With this reduction the horse may, without difficulty, draw a load of 8 or 9 tons over a perfectly level railway. With the same reduction an inclination of $30\frac{6}{11}$ feet per mile would, on a descending plane, be sufficient to overcome the friction, and cause the car to descend by its own gravity. The irregularities of the rails and the slight obstructions from foreign matter would be the same in all cases, and increase the necessary inclination. But in addition to the reduction of friction by the means already mentioned, there may be an application of the mechanical powers to *overcome* the remaining resistance, wherever the purpose to be accomplished will warrant an additional expense in the construction of the car; and where the additional machinery will not, on account either of its weight or complication, prove more detrimental than useful.

One of the most obvious expedients to augment the power of the wheel to overcome friction, would be to increase its diameter, while the diameter of the axle remained constant; because as the friction is proportionate to the weight, it would, for a given load, remain the

same on an axis of given size and materials, however high the wheel should be on which that load might rest. But, if the radius of the wheel be increased, the length of the arm of lever which overcomes this constant resistance is proportionally increased. Those who prefer the principle of virtual velocities for explaining mechanical powers, may consider, that with a wheel of double diameter the load will be conveyed over a double space on the rail, while the force applied is overcoming that amount of friction which results from a single revolution of the wheel on its axle. This mode of overcoming friction has, however, the disadvantage of carrying the axles too high, and of exposing them to the injurious effects of a powerful lateral pressure when the two rails are not precisely of the same height. The changes of form in the wheel itself would likewise require attention, when its height should be greatly augmented. But it is not necessary to dwell on the defects of the high-wheeled carriage. The committee have only referred to it as one of the expedients by which it has been attempted to overcome, in part, the friction on the axle.

The description of Winans' railroad-carriage, contained in the Journal of the Institute for April last, is so full, as to require but little explanation from your committee. The mode of overcoming the friction of the axle, by causing the ends of it to revolve within the rims of friction-wheels whose axes are below that of the travelling wheels, is certainly a very ingenious device.

It is not perceived by your committee, that the mere circumstance that the first and second orders of the lever are combined in the forms of the wheels of this carriage, is of any peculiar advantage in overcoming friction, since the principle of action and amount of power gained by the two orders is precisely the same. All the superiority which this circumstance imparts to the car before us, arises, therefore, from the convenient arrangement of the parts. It is a decided advantage in point of firmness and compactness of structure, that the friction-wheels require no additional fixtures with which to attach them to the load frame, except such as constitute in fact a part of that frame itself.

The liability of common railway-carriages to heat the gudgeons when moving with great speed, is a practical difficulty, which appears to be entirely removed by transferring the rubbing surface from the axes of the *primary* to those of the *secondary* wheels. The latter will always move so slowly as to preclude the idea of much increase of temperature from friction.

It will be observed, that the load now rests on eight bearings instead of four; the number found in every four-wheel carriage of the simplest construction. This allows the gudgeons of the *secondary* wheels to be less in diameter to support a given load, than those of the *primary*. A single revolution of the *secondary* wheel will, therefore, present a less number of rubbing points to any part of the bearing, than would a revolution of the primary wheel, whose axis is of double diameter to that of the former. And the leverage is greater where the diameter of the gudgeon is less; so that if the strength and other properties of materials allowed a very great diminution of the axle, the smaller it could be made the better.

The friction is, doubtless, as stated in the description above referred to, nearly proportional to the weight; but when the weight is constant, and the motion of the rubbing surfaces uniform for each case, the *sum of all the resistances* due to friction is proportional to the number of units of rubbing surface brought into contact during a given time. If this be true, it is of great importance to form the pivots of the secondary wheels in such a manner as to rub on their bearings through the least possible space, while the carriage passes over the greatest possible space on the road.

The model performs in a manner sufficiently decisive of the advantage which the principle of its construction has over that of the simple car in overcoming friction; but your committee would hesitate to receive the performance of this model as a certain indication of what may be expected from the machine of full size on a common railway.

Nothing but actual experiment on a large scale will fully develop the precise amount of advantage of a machine of this nature, because it is not possible to foresee all the circumstances which will attend its construction and use. If confined to a straight, level road, there can be no doubt that the power of the mover would be greatly increased by the addition of friction-wheels. The same may be said where the carriage is employed solely in transporting loads

down an inclined plane. But in conveying loads *up* an inclined plane, the additional weight arising from the friction-wheels would increase the gravitating power of the load. With the common cars, as perfected in England, the horse could draw up a plane inclined 30 feet per mile, only one-half as much as he could draw on a level; because, as before stated, the effect of gravity would there be just equal to friction, computing the latter at $\frac{1}{11}$ of the load. Now, if the car of Mr. Winans enables the horse to draw 56 tons on a perfectly smooth and level road, where friction only is to be considered, it would require the strength of about $7\frac{1}{2}$ horses to convey the same load up the inclined plane just mentioned.

This would seem to decide in favour of confining the use of this car, if adopted at all, to level roads, or to those on which the transportation is descending, or at least to those on which stationary power is employed in surmounting elevations.

As the invention has been presented with a request that its merits and defects may be closely scrutinized, your committee have thought proper to present some of those points in which it seems likely that this carriage may be found inconvenient, or defective, in its practical application.

The first of these arises from the shortness of the axes of the secondary wheels, compared with the diameters of those wheels themselves, by which they will be liable to act as bent levers, and twist the side pieces of the frames out of their natural positions, or to wear, unequally, the two bearings of those axes.

Second. The latter effect will, it should seem, be increased by the swagging of the load from side to side, in consequence of the arrangement by which the ends of the axes of the primary wheels act against the flanches of the secondary. Now they always act *outward*, and on one wheel at a time for each axis; consequently, there can be no restoring tendency, by which, when a friction-wheel is pushed out of its vertical position, or its inner bearing is worn more than the other, the evil will be likely to be corrected.

Third. The imperfection of castings and other workmanship, may possibly allow the friction-wheels to be worn in one *or more places* on the inside of each rim, to such a degree, as to allow the gudgeon to turn in the hollow part, as in a common bearing, and thus to prevent the secondary wheel from revolving. Should this be the case, the friction would, for that gudgeon, be reduced to that of the simple car.

Fourth. The friction-wheels must be made heavier than if the pressure of the primary axles were applied to the *outside* of their rims: because, in the latter case, the arched form of the part to which the pressure is applied, would conspire with the cohesion of materials to prevent the fracture of the rim, but the cohesion of parts must alone sustain the pressure in the case of the car at present under consideration.

Finally, as the axes of the primary wheels do not constantly preserve their parallelism with those of the secondary, the gudgeons of the former may be irregularly worn, in consequence of the obliquity which they may assume to the cylindrical surface of the interior of the friction-wheel; and the same circumstance also allowing the whole pressure of a gudgeon to be occasionally brought upon the edge of the rim of a friction-wheel, this part must be made strong enough to sustain the whole weight.

In conclusion, your committee would express a wish to see a carriage on this construction of full size put into operation, believing, that on levels and gradual descents, at least, it may be found eminently serviceable; and not doubting, that the same ingenuity which devised the construction, would supply the defects which we have pointed out, should they prove to exist, or any others which experience might demonstrate to belong to the peculiar construction now exhibited.

All which is respectfully submitted.

REPLY OF MR. GILMAN TO THE REMARKS OF "A PRACTICAL ENGINEER."

Sir,—The scurrilous effusions of an anonymous writer merit little attention under any circumstance; and the *motives* of the "Practical Engineer," whose communication appears in your last Number, are so very apparent, that it seems almost superfluous to reply to the brilliant tirade of which he has delivered himself. He has been evidently much galled by the paper on which he animadverts; perhaps it has blighted

some darling project, destroyed some golden harvest expectant. Smarting under the feelings excited by its perusal, he appears to have hastened to explore every patent which has the smallest bearing on the subject; but seeing things only through a distorted medium, he has discovered nothing but analogy, where in all probability none exists. I have seen *one* only of those patents to other parties, which he enumerates, and nothing in that bears the least analogy to my plans. With respect to the old patent in which my own name appears, when all is made known in regard to the share I had in its formation, a very sufficient reason will be unfolded for my making no reference to it in the paper which has provoked the ire of the "Practical Engineer." But if the existence of that patent proves my want of candour, how will this *worthy* stare when I inform him that there is yet another patent that has escaped his search —which was sealed while the apparatus which has vexed him so much was in operation—and yet, strange to say, it contains no allusion to the plans in dispute!

Before, however, indulging the "Practical Engineer" with any explanation of these things, I must first call on him to put in an appearance, as the lawyers call it, by subscribing his *real* name and *address* in the "Mechanics' Magazine." We shall then meet upon equal terms. Had he been honourably disposed, he would have done this at once, and rendered this request unnecessary. I care not, friend "Practical," who thou art; only come forth in thine own proper person, and I will balance accounts with thee, item by item, when we shall see on which side the want of candour lies.

I will just, in the mean time, observe generally, that it never was pretended that the apparatus in question was perfect, or of the best form for general use; and perhaps I know its defects quite as well as this man of *wisdom*, who, with all his *practical pretensions*, treats of imperfections which never existed. The apparatus was arranged solely for our *then* purpose, and whether defective or otherwise, is of no importance to the question at issue; it does not in the least affect the principle it was designed to illustrate—which principle indeed is left wholly untouched by any thing the "Practical Engineer" has advanced. I could have *produced* many drawings that perhaps this "Mr. Errorless"* would say were not objectionable; but if I had taken either of them instead of the one that was really executed, merely on account of these blemishes, for the Magazine, then perhaps I might have been justly charged with a want of candour. Even that however would not have warranted Mr. "Practical's" unjust attack, as it would neither have altered the principles of the plans, nor changed the time when those principles were conceived.

But *the joints!* Aye, the joints. Did he never see such a joint? Perhaps not. What a pity! Has he ever seen any thing of high-pressure steam? Perhaps not, also. I will tell him thus much, that when I want a cast-iron joint particularly sound, and when circumstances will permit, whether that joint be square or circular, I never trust to cemented flanges; and farther, that the parts in contact to form my joints seldom exceed three-eighths of an inch wide. In this case they were not one-half of that width, and I can show a hundred as sound as if they were solid metal. But the *bolts*—even the bolts too, were really sufficient to confine and actually did confine steam of between two and three hundred pounds per inch, and keep sound joints too; and strange it would have been, in my opinion, had they not.

So much for "Practical's" experience; but I have forgot the *pipes*. Aye, they are uncovered and oxidising, and I must hasten to a conclusion. Did "THE NOVELTY'S" *sore place* suggest this idea? I believe "Practical" says something about my intention of blowing up "THE NOVELTY," aiming a blow at it, or something of the kind. Indeed, I should have suspected him to have been one of those "wot drive THE NOVELTY," had not his bitter acrimony, his false-coloured and vindictive rigmarole, convinced me that it is far beneath any thing that the proprietors of that engine would descend to. When we meet again, friend "Practical," we will say something more on this subject —and likewise on *pour carbonic* acid, &c.

Now, Mr. Editor, to conclude—had this "Practical Engineer" wished for information, it would have been furnished with great pleasure, either through the medium of the "Mechanics' Magazine," or privately, if he de-

* "Thou perfect soul, drawn by the gods in council,
Which they were long in making,
—At thy birth the heavenly council paus'd,
And then at last cried out, This is an errorless man."

sired, and had applied in a proper way. But instead of even applying at all, he has thought proper to indulge himself in a mode of attack which leaves him entitled to no consideration on my part. Though perhaps it is of small moment, Mr. Editor, yet even you can say that the drawings which appeared in your Magazine were in your hands I think about fifteen months ago.* They would have been published years since, but for a private reason, which it is not necessary here to mention.

I am, Sir,
Your humble servant,
WILLIAM GILMAN.

Jan. 4, 1830.

P. S.—I hold it to be a sacred duty of an Editor to allow both sides of a question to be heard without favour to one or the other; and I should have been much disappointed in my opinion of the Editor of the "Mechanics' Magazine," if he had not done as he has in regard to the present matter. Allow me, however, to say thus much—that I think so long as the question is conducted in a fair and bonourable manner, it matters not whether the disputants appear under their own or under assumed names; but when either descends to acrimonious invective and personality—which is not argument, only a proof indeed of conscious weakness—then you ought to exercise your editorial power, and not publish without name and address. This, in my opinion, is but justice; otherwise, any malevolent fellow may raise a storm that may cause a great deal of trouble, and perhaps injure a man's character—while shielded under an assumed name, he can never be identified, and therefore made to suffer the penalty due to his baseness.

As the call made by Mr. Gilman on a "Practical Engineer" to come forward in his own proper person, implies a censure on ourselves for permitting him to enter the lists with his vizor down, and as Mr. Gilman indeed has *lectured* us pretty sharply in his P. S. on the subject of inserting anonymous communications, (admitting, strangely enough, all the while, that we could not, in the present instance, have done otherwise than we have done,) we must be excused for subjoining a few words on the subject. When a person comes forward, like Mr. Gilman, partly in the character of a patentee, and partly in the character of a public benefactor, to claim the credit of having invented something useful to society, with whom is he supposed to deal on the occasion? Is it not with the public, from whom he hopes for a reward, in some shape or other, for the service he has rendered? And is not the name of that public—LEGION?

As these questions, we apprehend, admit of affirmative answers only, we hold that it matters not a jot which individual of that public it is, A, B, Y, or Z, who undertakes the task of investigating the originality and usefulness of the invention in question, or whether he comes forward in his real or in an assumed name. It is sufficient, in our opinion, that he is one of that public, to whom the invention is offered, and from whom an adequate return for it is expected by the inventor. Neither can the *manner* in which a person executes such a task furnish any solid objection to his being heard. The worse the manner of the attack, the better for the individual attacked.

The strictures of the "Practical Engineer" who has acted the part of public censor, in the present instance, did appear to us, we confess, to be couched in language unnecessarily harsh; but they exhibited, at the same time, too formidable an array of facts (seeming facts at least) to allow of our refusing them a place, merely because they happened to be not quite to our taste. Mr. Gilman seems well disposed to leave his opponent nothing to boast of on the score of courtesy; but in this we humbly presume to think he acts not very wisely. Strong words are best replied to by strong reasons. He may rest assured, that he has but one prudent course to take, and that is, not to stand on conditions (least of all on the foolish one about the name of his assailant), but *to grapple at once with the facts of the case.*—EDIT. M. M.

ON THE ADVANTAGE OF CAST-IRON BRESTSUMMERS, &c. IN BUILDINGS.

Sir,—In my former reply to Mr. Baddeley, jun., I did not advert to "the cast-iron brestsummers," which he thinks so secure. Although he admits the chance of their being broken to be within the bounds of "possibility," yet he deems my notice scarcely worthy of his attention. But the "possibility" of such an occurrence being admitted, if a substitute

* *A fact.*—EDIT. M. M.

or a remedy can be thought of, I am convinced Mr. Baddeley will be amongst the first to give it his consideration. I will therefore venture to give a hint. The very great strength of wrought-iron as a tie is well known. Its use in suspension-bridges, and to strengthen or truss wooden beams, may be mentioned. Indeed, the great advantages of its application to the latter, has led to the idea that it may also be used both to strengthen cast-iron beams, &c., and to render brest-summers of that material perfectly secure. But this is not all, cast-iron girders, &c. thus supported need not be so heavy; and, indeed, I am not without hopes that beams built of brick and Roman cement may be so effectually supported by wrought-iron ties, as to enable them to carry a considerable load.* And if beams can be made of brick, so may the whole of a floor. I am aware brick arches have been turned between cast-iron girders; but I do not know that any attempt has yet been made, although I see nothing to prevent the principle being carried from wall to wall over any moderate-sized apartments, so as to construct fire-proof floors, or even roofs, at the least possible expense. Cast-iron abutments may be placed upon the walls, and the tie-rods may be about a foot apart. If the room be 20 feet wide, the splay of the abutments may be in the direction of a radius that will describe an arc with a rise or versed sine of 6 inches. This arch being constructed of 9-inch brick-work, on the principle of a jack-arch, we may have a brick ceiling and floor nearly level. A rise of about 2 inches in the middle of the ceiling is recommended. The iron ties may be so much above the spraying of the arch or bottom of the abutments, as to be entirely (say an inch) within the bricks at the middle of the ceiling. Instead of sleepers, joists, and ordinary flooring-boards, I should recommend thick or plank floors only, ploughed and tongued together, and fastened to the brick-work. The wooden floor should be laid in the direction of the iron ties.

I may just notice here that I am *glad to* observe Mr. Baddeley has *turned his* attention to the new policemen, as the persons from whom the greatest benefit is to be derived in the event of fire. As far back as vol. ix. p. 163, I ventured to express a doubt of the utility of a double set of nightly watchers, or both watchmen and the men to be trained by the "Society for Preventing the Loss of Life by Fire." The observations then made were under the old state of things; but under the new such remarks will be the stronger.

I remain, Sir, &c.

J. S. S.

MISCELLANEOUS.

Perkins' Steam-Cannon.—The first experiments made with Perkins' Steam-Cannon at Vincennes, near Paris, were not attended with very brilliant results; and it appears that the last have not been more fortunate. The enormous apparatus of which this machine is composed was placed at about forty paces distant from a wooden figure formed to represent the hull of a man of war; the projectiles thrown were about four pound calibre, and remained fixed in the thickness of the wood: a four-pounder was afterwards fired off at the same distance, and the ball penetrated the figure. Other experiments may possibly give different results; but even allowing that the superiority of Perkins' cannon becomes perfectly established, the complication of the machinery and its enormous proportions will render its application to the arming of ships almost impossible.—*Journal des Connaires; United Service Journal, January*, 1830. It would seem then after all, that the Duke of Wellington was not so far wrong in pronouncing that Mr. Perkins' cannon would never answer.

Astronomical Phenomenon.—On the evening of Sunday last, the Moon was distinctly seen at Tynemouth with the naked eye 37 hours after the change—a very extraordinary circumstance in this country. Some of the oldest seafaring men declare they never saw the phenomenon before.—*Globe, Jan.* 3.

INTERIM NOTICES.

As the Inquiry which was commenced in the last Session of Parliament into the evils of the Patent Laws will doubtless be resumed on the re-assembling of Parliament next month, and it is of the utmost importance that all who are engaged in mechanical pursuits, or who take an interest in mechanical improvements, should be in possession of the Minutes of that Inquiry, as far as it has yet proceeded, we propose to give an abridgment of the same in small type in a Supplementary Number next week.

J. G. N. very acceptable.

Communications received from Mr. Saddington—Mr. Baverstock—J. Syngleman—Mr. Mr.—Mr. J. Gilbert—J. F. C.—J. O. B.—Henry P.—S. P. W.—Mr. Jopling—Mr. Davy—W. B.

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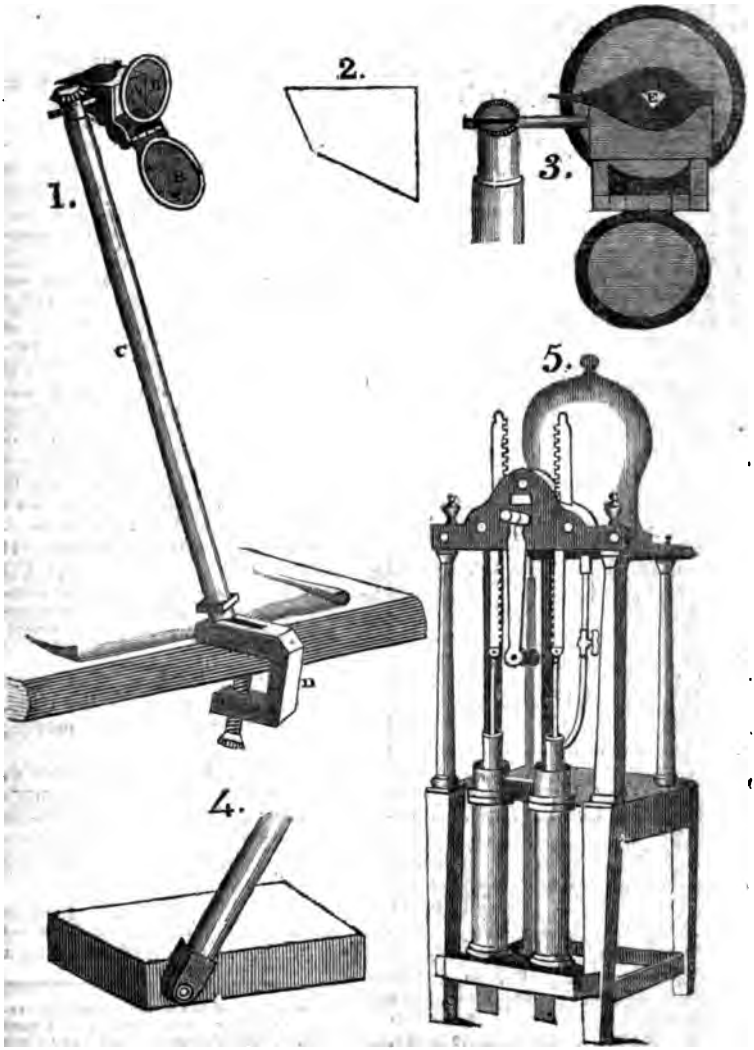
THE CAMERA LUCIDA.



DESCRIPTION OF THE CAMERA LUCIDA, AND SPECIMENS.

Sir,—I have taken the first opportunity of replying to your correspondent J. O. B.'s query (p. 128), "Does J. understand the use of the pantagraph?" Indeed, Mr. J. O. B., I *do* understand as much as there is to be understood about it; and, moreover, if you or any of your friends are in want of such an article, I shall be most happy to supply you with a *splendid* pantagraph of the best workmanship, and in perfect order, at a very cheap rate: for the reason why I pronounced the aforesaid instrument unwieldy, &c. was not from mere whim, prejudice, or the want of knowing better, but because I have *found it to be so* from actual and repeated trials. It is right, however, to state my reasons for using this term. A pantagraph of wood is worth little, because it will warp; and a *warped* pantagraph is useless, or nearly so. Secondly, this instrument is of little *general* use, unless it is of what opticians call a "full size" (three feet). Thus the best pantagraph will contain *several pounds* of solid brass; and though you may undoubtedly have one which is neither large nor unwieldy, it will be nothing better than a kind of child's plaything.

I assure you, Mr. Editor, I could fill one of your pages with a minute detail of the inconveniences attending the *use* of the pantagraph, but would not, on any account, occupy your valuable room with what I consider so worthless a subject.

I have enclosed sketches of several of the articles in my studio, and hope that they may give to those to whom you may show them, some idea of of what the *Camera Lucida* is capable.

No. 1 is a portrait. I shall feel pleased if you are able to make out who it is meant for. It is but justice to myself to state, that it is the first attempt I ever made at likeness-taking; and, I assure you, I was literally astonished to find what assistance this unique little instrument gave; and do not hesitate to say, *that I will* copy the most elaborate *piece of* sculpture, were it the Laocoon itself, in the same way with equal facility.

N. B.—It was all, both outline and shading, done by the assistance of the Camera Lucida; and although, as you will easily perceive, it is the work of a mere novice, yet, in justice to the instrument, I must say that I could do much better; but I am rather pressed for time, and it was done in haste.*

No. 2† I selected as being a very difficult subject. It represents the American double-barrelled air-pump. There is no man in the United Kingdom who could make a correct copy of this complicated instrument without the Camera Lucida; with its assistance, it is nearly as easy as to white-wash a wall; and you will perceive that the perspective is absolutely perfect.

N. B.—This pump is made on an excellent principle, the valves being *mechanically* opened by the handle itself. It is the most simple, permanent, and accurate pump that is made; and superior even to Cuthbertson's, (vide Pneumatics, Enc. Brit.) which is too complicated, and too apt to go out of order. The two front pillars are left white, being of polished brass. The brass work in general is made light. The dark parts are mahogany or ebony. It exhausts 600 times, and when put in fine order much more. It is altogether the most beautiful instrument I ever beheld. It was made by Jones, 30, Holborn.

No. 3, is a representation of a small model of Vauloue's pile-engine, which goes by an internal moving power.

As to No. 4 (figure of a chair), No. 5 (a sofa), and No. 6 (Jones's best circular-fronted barometer—an exquisite piece of workmanship), they are merely put in with intent to show the great use this instrument might be of to artisans: to put even a chair into correct perspective, is no easy matter; by means of the Camera

* The subject of this sketch we *at once* recognised to be Sir Walter Scott. It is a good likeness, and furnishes an admirable proof of the capabilities of the Camera Lucida. — Edit. M. M.

† Fig. 5, in our front page.

Lucida, it may be done in less than five minutes.

J. O. B. says, he wishes I would furnish a drawing and description of the instrument in question, as he cannot find it in the Encyclopedias. I do not know what works bearing that title he may have examined; but had he chanced to stumble upon the "*Supplement*" to the Encyclopedia Britannica, which (I hope it will not infringe upon the advertisement act to say so) is by very far the best work of the kind extant; he would have found not a "slight notice" of it, but a copious and accurate account of Hooke's Camera Lucida, as improved by Wollaston, illustrated by a quarto engraving executed in the first style of art; and to this I refer him. But as there are, doubtless, many of your numerous readers to whom this instrument would be of extensive use, who may have no opportunity of seeing so expensive a work, I have considered it best to comply with the request of your correspondent, and now proceed to give a drawing and description of

THE CAMERA LUCIDA,

An instrument for drawing objects in true perspective, and for copying, reducing, or enlarging, other drawings.

The instrument, as represented in the figures, may be used with the small round glass, A B, turned up in front, (fig. 1.) or with the larger glass turned up level underneath the instrument (fig. 3 seen from above). But those who are short-sighted can only use the former, and persons that are long-sighted must use the latter. D is the clamp and screw for fixing the apparatus to the table. Mine (which was made some years ago, and is of course now "old-fashioned,") is, in my opinion, much better; being constructed with a solid, square foot of brass, (fig. 4.) and I use a *detached* clamp. I could give several reasons why I consider this plan preferable, but it would fill much space. I will now give a few of the *principal* directions from Dollond's conspectus supplied with the instrument.

Fix the instrument to the table *and paper, as shown in fig.* 1. Turn the prism (shown more distinctly in fig. 2.) on its pin till the rectangular face be placed opposite to the object to be delineated. The black eye-piece, E, will then be uppermost; and, on looking through the small aperture therein, the artist will see the object he wishes to draw, apparently distributed over the paper. The object is shown beautifully, and without the least *coloured refraction.*

N. B. The eye-hole is to be so placed, that half of it is over the prism, and half over the paper; and as the eye is larger than the eye-hole, the observer sees paper and pencil through the nearer half, and the object at the same time through the further half, and thus has only to trace the lines, as well as his skill, or steadiness of hand, will enable him.

In copying drawings, the copy will be larger or smaller than the original, according as the prism is more or less distant from the paper, than it is from the drawing to be copied. Thus, if the drawing be two feet from the prism, and the paper only one foot, the copy will be half the size of the original. If the drawing be at one foot, and the paper three feet distant, the copy will be three times as large as the original; and so for all other distances.

Though I have studied to be as brief as possible, and have been much more so than I could have wished, yet still this paper has run out to some length. I will, however, observe, that should what I have here stated be the means of exciting J. O. B. (or any other person) to write in opposition to me, and say what can be said in defence of a subject, which I am certain is utterly indefensible, I pledge you my word that I will not reply to it. For, though I would have your readers, as honest Captain Mac-Turk says, "to know and to believe, and to very well consider," that the Camera Lucida will do all that the pantagraph will do, and in a much better style, and also a very, very great deal that the pantagraph can *not* do; yet I will not be the means of filling your pages with a lengthy and eccentric-chuck-

like discussion about a subject which is as evident as the light of day.

To conclude, it is an ill wind that blows nobody good. One man at least is filling his pocket by means of the pantagraph: for, if your readers will look at Mr. J. O. B.'s diagram, and imagine one of the arms behind a transparent screen, and the other connected with the arms of a moveable-jointed doll, they will easily understand the contrivance of *Prosopographus*, the automaton artist. The patient's head is wedged into a place in the back of a chair, where it is held firm, whilst the *artist* goes behind and traces the outline of the face (which is thrown upon the screen by a gas light); he afterwards does it over with black. But you will observe, that it can only take profiles; whereas, by means of the Camera Lucida, we can take full, or three-quarter-face likenesses at pleasure: thus leaving the above-mentioned little gentleman far in the back-ground.—We may truly say of it, what Arbuthnot said to Mr. Pope of the genius of Handel, "Conceive the highest of it that you can, and it is much beyond any thing you can conceive."

I had nearly forgotten to observe, that I have added to the sketches sent to you a Camera Lucida sketch of Cary's Map of England and Wales, in order to satisfy your correspondent that it is applicable to this purpose: but I may observe, that map-drawing is one of its *lowest* efforts. In tracing a map, I will make the pen or pencil run like a snake on the ground, and it shall still be correct. Indeed, to suppose the instrument unfit to copy a mere map or chart, when it will copy the most perfect likenesses of the human face, is like questioning a man's ability for leaping over an ink-stand, when we have seen him with ease clear a five-barred gate. The map is reduced to about 1-12th the original size.

I am, Sir,
Your obedient servant,
Exeter. H. J.

P.S.—Though I am afraid it is rather improbable, yet if any of your *correspondents* should happen, on *business* or otherwise, to visit this part, I will with pleasure give them a *practical* conviction, that what I have here stated concerning this instrument is not exaggerated. You have my address.

RAIL-ROADS.

Sir,—As to my proposition, in your Magazine, of Oct. 24, 1829, No. 324, your correspondent C. H. has mistaken my intention, as to the use or application of the power to propel the carriages along the railway with rollers only. I contemplated the use of horses or stationary engines, as the locomotive engine, I conceive, could not be employed upon a way so constructed without difficulty. In my opinion, however, either horses or stationary engines might be employed; and this for various reasons, which may be demonstrated with as much ease as any of the simplest propositions of Euclid.

I beg, Mr. Editor, you will insert the above in your excellent Magazine, for the purpose of setting your correspondent C. H. right, as he thinks, were horses used, the scheme is worthy a thought, and that all difficulties would be removed. I am sorry he has put a misconstruction on the scheme, as I never intended any other power but that of horses and stationary engines to be applied.

Not only will the expense of such a road be diminished, but you may form an idea how trivial the expense will be of a waggon adapted to travel along a way so constructed, as it will be more of the nature of a sledge, having neither axles nor wheels, but barely a rail on each side of the carriage, either of cast or malleable iron, as you please. If the mode which I have pointed out be found less expensive and equally effectual in practice, it will be a vast saving to the owners of the collieries upon the Tyne and Wear, as well above ground as beneath, and perhaps more so than in any other district in this kingdom.

I am, Sir,
Yours, &c.
Jan. 4, 1830. W. B.

N.B.—In my next, I will enter more at length into this subject.

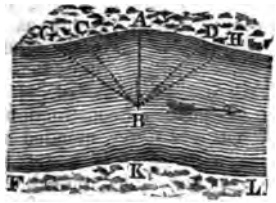
ON THE REMOVAL OF DEPOSITS OF EARTH IN TIDAL RIVERS, AND THE PROBABLE EFFECTS OF REMOVING THE OLD LONDON BRIDGE.

(Concluded from our last Number, p. 339.)

As to the practical construction both of jettees and of these water-turners, so as they will probably have to be used in the Thames, it is better shown in Dover Harbour than in any place in England which I have visited.

The effect of a jettee, whether permanent or temporary, of an apron, or other water-turner, when placed in a river, depends principally upon the velocity of the tidal or other stream, and the breadth of the passage which remains between the projecting head of the jettee and the opposite bank or beach. In many cases, the angle which the jettee makes with the bank from which it protrudes is not of so much consequence.

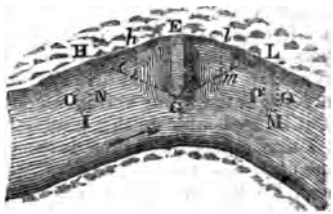
Fig. 1.



Let AB be a jettee projecting perpendicularly from the bank CD of a river, the stream moving onward in the direction of the arrow-head. The mass of stagnant water CBDA which will result will remain nearly the same, although in the direction of BA, provided that its head remains at B, and that it is posited within the space CBDA. It will only happen that the mass of stagnant waters will diminish on one side of the root or insertion A, and augment on the other, so that the entire mass will posite itself above the jettee, if it be placed in the direction BD; while, on the contrary, it will be found below the jettee or apron, if it be placed in the direction CB. But, if we place the jettee in a direction at GB, out of the mass of stagnant water CBDA, that mass will be augmented below the jettee by the space GBC, while, *probably, it will be diminished* a little between BD and BA: yet, if the jettee were posited in the direction BH, it would not produce about BC the same effect that one placed at GB would near BD.

In the case where the purpose of the apron or jettee is to remove a deposit at K, or to gain upon the opposite bank there, the main object is so to contract and divert the stream that it shall strike at K with the greatest force to wear away the obstacle. In those parts of the country where land bounding a stream is valuable, its owners have been sometimes known to increase it by planting osiers or willows upon its banks, which, as their roots protrude, cause a corresponding abrasion into the opposite side of the stream. Then, in a few years, the old trees have been cut down, and new ones planted still closer to the water; and thus by successive, imperceptible thefts upon the opposite neighbours, an estate running for a mile by the side of such a stream has been increased by some acres.

Fig. 2.



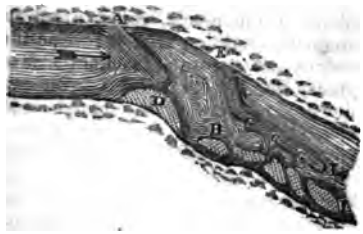
When the mass of dormant waters, occasioned by a jettee EG, would cover and occupy the whole of a great hole in the bed of a river, which it is proposed to fill; and when the river is not too deep towards the middle of that hole, a single jettee EG is preferable to the two, HI and LM; both because the two would probably cost more in their construction, and because there would be occasioned by these two deposits, O N, P Q, on both sides of them.

If the jettee EG is not competent to produce a quantity of stagnant water, sufficiently extensive to accomplish its operation upon the entire hole, it will be proper, instead of that, to have two smaller ones hi, lm, but

still posited within the space which it is intended to fill up. But it is in all cases an error to put two large jettees quite beyond the space to be filled, one above it and the other below it, with respect to the stream.

Whatever be the position of a jettee or apron, such as A (fig. 3) when it is intended to remove an obstruction, it will operate best upon the salient angle of one that is within a moderate distance of its extremity, as D. In the case where there is a continuous deposit of mud, or gravel, to be removed, a jettee with an angle, as

Fig. 3.



EL, which will reduce the river in that part to a narrow canal, will answer best. In most cases, this must, of course, be a temporary apron to be erected occasionally for a few days, then taken down, and after a few days erected again. To render this construction still more efficacious, little angular spurs, G, G, G, should be placed in well-chosen positions. There may, indeed, be hooks, pins, &c. along EI, to facilitate changing the positions of these spurs, as may appear expedient, and as the operation of reducing the deposits may from time to time suggest.

In some cases, two aprons placed as AB, CD, provided they are not too

Fig. 4.

remote from each other, will be very *operative*: for the water becoming in *great* measure stagnant between AB and CD, contracts the stream between BD and EF; and thus causes it to wear away the deposits shown in the figure, nearly as it would if there were a wall or apron extended from B to D.

It is often not merely advisable, but in great measure necessary, to assist the operation of the artificial streams thus produced, by cutting little trenches in various directions across the accumulations which we are desirous to remove. These trenches are exhibited in figs. 3 and 4; other varieties are given in figs. 5 and 6, below.

Fig. 5.

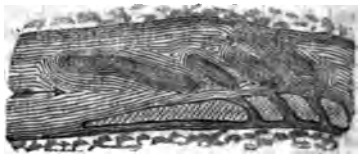
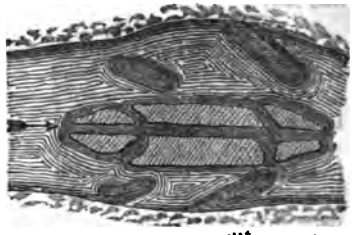


Fig. 6.



The last four figures, &c. exhibit the most advantageous positions, which might, in various instances, be given to the aprons or water-turners.

These methods, and others of bringing the tide or other stream so to act upon deposits as to diminish their magnitude, and ultimately to remove them, are doubtless well-known to several of our civil-engineers. But I know of no English book in which their nature and application are explained. They cannot, of course, be used upon the Thames between London and Westminster Bridges, without some such contrivance as the sluice-gates already spoken of. It may be well, therefore, to devise, before absolute necessity calls for their adoption, some means of *letting* up the flowing tide as freely as we please, of keeping up any portion of it

that we please, and of *letting down* the remaining portion in such quantities and directions as shall best serve to cleanse the river, and keep it in a navigable state.

All that is now offered, however, must be regarded in the light of mere suggestions; to be improved upon, as I earnestly hope, by some of your more experienced correspondents. Diversity of soil, varieties in the nature of the deposits, modifications in the direction and velocity of the stream, may each and all call for corresponding diversities in the nature, durability, elevation, slope, &c. of the jettee or apron, and of the materials employed. I regard myself, therefore, as simply opening the door to a series of papers on this and kindred matters, by which, I trust, your valuable miscellany will instruct the public on a most momentous subject, and remain,

Sir,

Yours, respectfully,

Jan. 4, 1830. O. C. F.

ANSWER TO THE INQUIRY OF "AN INTENDING EMIGRANT," IN NO. 334.

Sir,—I send you an answer to the inquiry of your correspondent, "Aqueduct," in your last number,

And am, Sir, yours, &c.

Lynn, Jan. 8, 1830. J. UTTING.

First, we have given the length of the pipe=20 miles; the inclination or slope of the pipe=30 feet; and its diameter, half an inch. To find the velocity of the water at the point of delivery?

Now, according to the formula of *Du Buat*, we have $d=\frac{0.5}{4}$ and $\sqrt{d}-0.1=0.2535534$

And $s=\frac{105600}{30}=3520$, and $s+1.6=3521.6$

$\sqrt{s}=59.329588$, and $\frac{1}{2}$ hyp. log. $3521.6=4.083335$

Whence $\sqrt{s}$—h. log. $\sqrt{s+1.6})=55.246253$

Also $307\ (\sqrt{d}-0.1)=307\times 0.2535534=77.840891$

Hence $\frac{307\ (\sqrt{d}-0.1)}{\sqrt{s}-\text{h. log. }\sqrt{(s+1.6)}}=\frac{77.840891}{55.246253}=1.408980$

Now $0.3\ (\sqrt{d}-1)=0.076066$

Whence $1.408980-0.076066=1.332914$, or nearly $1\frac{1}{3}$ inches the velocity of the water at the point of delivery in one second.

Whence $\frac{1.332914\times 0.5^2\times .78539,\text{&c.}\times 60''}{1728}=0.0090874$ of a cubic foot, or 15·70303 cubic inches, the discharge per minute; or 13·08686 cubic feet per day.

Secondly, the slope of the pipe being 10 miles?

The final velocity comes out 1·960834 inches per second, and the discharge 19·25045 cubic feet per day.

Thirdly, the slope of the pipe being 15 miles?

The final velocity will be 1·564715 inches per second, and the discharge 15·36156 cubic feet per day.

Lastly, the slope of the pipe being 200 miles?

The final velocity will be 0·350735 of an inch per second, and the discharge 3·44333 cubic feet per day.

The velocity of the water will become nothing, when the length of the pipe greatly exceeds its inclination or slope, as it is evident that if 0·3 $(\sqrt{d}-0.1)$ becomes equal to $\frac{307\ (\sqrt{d}-0.1)}{\sqrt{s}-\text{h. log. }\sqrt{(s+1.6)}}$ that the water will have no sensible motion, but become stationary.

If every particle of the fluid passed in contact with the side of the pipe, since *in equal times* "they all experience the same degree of friction;" then the velocity would diminish in the direct ratio of the length of the

pipe, and would form a regular arithmetical progression; of which the first term would be the final, and the last the initial velocity of the water.

But it is only the lateral filaments that are exposed to friction—this retards their motion; and the particles of the fluid, or the adjacent filaments which do not touch the pipe by their adhesion to those which do touch it, experience also a retardation, although in a less degree.

The retardation of each particle of the fluid being inversely proportional to its distance from the side of the pipe.

Hence in pipes of small diameters, whose positions are nearly horizontal, the retardation of the fluid occasioned by friction is more than equivalent to the acceleration of gravity; and the fluid is consequently deprived of motion. And although the formulæ give in the last case a velocity of one-third of an inch per second, I much doubt whether or not the water would run at all; as it must experience a considerable retardation from the effects of capillary attraction in pipes of such small diameters.

P.S.—The above queries may be more readily solved by the tables given in the "Encyclopedia Britannica," vol. xx. pages 652 and 653; in which work I beg to correct the following errata: viz.

Vol. xx. page 654, col. 1, line 41, for log. 2·49472, read 2·48472. By correcting the subsequent part of the computation, the velocity comes out 19·425, instead of 20·08 inches per second; and the discharge 223·54, instead of 228·8 Scotch pints.

J. U.

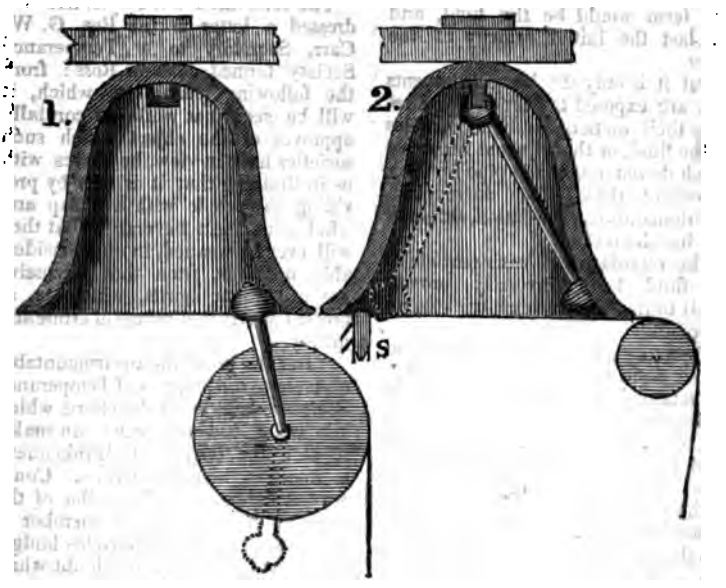
N.B. The inquiry, I think, is not properly defined, as it is not expressed whether the end of the pipe at the reservoir is placed level with the surface of the water contained therein, or whether it is to be placed 30 feet below the surface of the water in the reservoir; in which case the pipe would be perfectly *horizontal* in its whole length; which, I think, is not *intended*, although so expressed in the *inquiry*.

TEMPERANCE SOCIETY.

The celebrated Dr. Doyle has addressed a letter to the Rev. G. W. Carr, Secretary to a Temperance Society formed at New Ross: from the following passage to which, it will be seen that while he cordially approves of the object which such societies have in view, he agrees with us in thinking that it is only by providing the people with a cheap and wholesome malt beverage, that they will ever be weaned, in any considerable numbers, from that excessive use of ardent spirits, which is at present so fertile a source of crime and misery.

"But the great, the insurmountable obstacle to the progress of Temperance Societies, and to all the efforts which you and I, and such as we can make, to stop the torrent of drunkenness, is found in the revenue laws. Could we but induce the Chancellor of the Exchequer to become a member of our society, and to square his budget by our rules, I have no doubt whatever but we should succeed in removing this pestilence of drunkenness out of the land. To eradicate the use of ardent spirits out of a country having such a climate as ours, and from among such a people as ours, is quite impossible; but to diminish the use of ardent spirits to the one-fifteenth part of its present amount, is, in my opinion, perfectly practicable. But as it would be as easy to stop the mouths of the Euphrates, as to stop the mouths of those who now drink whiskey in Ireland, they cannot be reclaimed until a better beverage than whiskey is provided for them at even a lower expense. All this could be done by the Chancellor of the Exchequer, if he found it more necessary to promote good morals than to secure a large revenue. I am tolerably well acquainted with the making of malt and the brewing of beer, and I have no hesitation in stating, that if malting and brewing were exempted from tax, and the impost on whiskey raised, drunkenness in a little time would almost disappear from the country."

CHURCH BELLS, &c.



Sir,—I do not recollect any information that I have acquired from the "Mechanics' Magazine" that engaged my attention more forcibly, than the sketch of Mr. Drury's improved method of producing the sound of a bell, as given by Mr. Wm. Baddeley, jun. in your 331st No. of the "Mechanics' Magazine;" a subject entirely new to my mind. I earnestly hope that so important an improvement will not be suffered to expire in diagrams and theory. The whole scheme is so practically illustrated by Mr. W. B. jun., that if any thing be done successfully, it must, I think, be upon the principles advanced by Mr. Drury, so far, at least, as relates to the *immoveable fixture* of the bell; and the producing sound, by the *motion* of the hammer, or tongue of the bell. The perfecting of the invention by scientific means, I must, of necessity, leave to *persons qualified*; and would only humbly beg leave to suggest as a subject for *their opinions*—whether the improvement might not be put in practice on bells as they *already hang*. Why not strike the *interior* surface of the bell, *as hitherto (see fig. 1.)*? Or even make use of its present tongue (see fig. 2.)? The S. suggests a *stay* to the tongue of the bell, that it may not strike that side. The rest of the scheme coincides with the methods (or *some such* as those) of Mr. Drury's. The proper construction and applications must depend on local circumstances; and the scientific calculations of such as are capable of bringing so excellent a contrivance into actual operation. I only hope some more efficient pen and pencil may have superseded this slight suggestion, which I only offer, to preserve the scheme from sinking, and to excite the ingenuity of mechanics in the construction of what may be requisite to accomplish this improved method of ringing a peal of bells. As for the improvement that may be still wanting in the *formation of bells*, let it not prevent this capital thought of Mr. Drury's from being applied to bells, *as they are at present*. Let the bell-founder and the architect lay their heads together, for the more perfect *making*, *fixing*, and *ringing bells, consonant with the safety of their* towers. I am, Sir, yours, &c.

C. H.

FRENCH AND ENGLISH NAUTICAL ALMANACS.

We have just received the *Connaissance des Tems*, or French Nautical Almanac, for 1832. We are glad to learn from it, that the French Board of Longitude do not so pertinaciously resist all hints for improvement, as the late English Board of Longitude did; and, comparing little things with great—the ants with the elephants of the almanac tribe—as the managers of the British Almanac have done.

The French Board announce various improvements, some of which will be introduced in the *Connaissance des Tems* for 1833, others in that for 1835. Among the first, we are very glad to find specified "the angular distances of Venus, Mars, Jupiter, and Saturn, respectively, from the moon," after the manner in our Nautical Almanac of the distances of certain fixed stars from the moon, at intervals of three hours. It is a curious fact, in the history of attempts to *prevent* the promotion of science, that Professor Schumacher, of Altona, (one of the first astronomers, and one of the most public-spirited men in Europe,) got these distances of the planets from the moon accurately computed for every three hours in an entire year (about eight or nine years ago), offered them gratuitously to the English Board of Longitude, and said he would engage to supply them annually, free of expense—simply requiring a certain, and not a large number of the printed copies, to circulate amongst Danish and German astronomers, and naval men—but that THIS LIBERAL OFFER WAS POSITIVELY DECLINED! Mr. Schumacher, therefore, published them separately; and the East India Company, and some other public bodies, have procured copies regularly from Altona, year after year.

We rejoice to hail the improvements in the *Connaissance des Tems*; and trust that, ere long, we shall have to congratulate Messrs. South, Baily, and others, who have struggled nobly to accomplish so desirable an object, on the appearance of similar improvements in our own Nautical Almanac.

ON THE FORM AND ACTION OF THE TEETH OF WHEELS.

Sir,—As the most eminent authors are not free from errors, and compilers or book-makers copy from authors and from each other, thereby propagating such errors, it cannot be questioned but your correspondents ought themselves to understand the subjects on which they may think proper to offer remarks. Indeed, nothing is more certain than that those who square their ideas entirely by what they read, without any judgment of their own, are by no means fit persons to assume the office of censurers. "S. Y. (a Young Engineer)," No. 332, p. 304, presuming on what he has seen in print, asserts that my remarks on the acting of the teeth of wheels are not such as might have been expected from one who pretends to treat the subject scientifically; and that "the best mode of forming the teeth of wheels is by involutes of circles:" and in support of his assertion, he refers your readers to Gregory's *Mechanics*, Robison's *Mechanical Philosophy*, *Ency. Brit.* and Rees' *Cyclopedia*. But although the epithet he gives himself of "young" may plead an excuse for the want of knowledge, it is certain that such want but ill accords with the title of "engineer." He tells us that the teeth of wheels working three inches deep, only *slide* on each other one-sixtieth of an inch; but he does not show us by what magic this is effected.

Now, as it is much better to be guided by strict matter of fact than merely by what any author whatever may happen to advance, there is no necessity for me to consult the authors he refers to—there being no difficulty in proving that *the true form of the teeth of wheels* are epicycloids, and consequently *not involutes of circles*; and that they rub or slide more or less against each other the whole depth they work into each other—the curved part of the teeth of one wheel sliding against the straight part of those of the other, the point of contact changing continually in both.

It would be deemed futile to make any remark on *the wearing of the teeth*, seeing that *it is the obvious consequence* of their sliding *against each*

other. Nor need any one be told, that if there were *no sliding* there could be *no wearing*: but the fact of their wearing, and the manner in which they wear, ought to have convinced "S. Y." that there is a degree of sliding the whole depth they take hold of each other; and which is so considerable in the low numbers of the pinions of clocks, as to render the beneficial effects of rollers very sensible.

It is true that at the line of centres of two wheels there is no sliding, because at this point both wheels move in the same direction; but as in receding either way from this line, the direction of the motion of the two wheels is more and more different, and the driving-wheel continuing to press the other wheel forward through all angles comprised between the point where the teeth enter in and that where they come out, the sliding necessarily becomes greater and greater, and in a greater ratio than that in which the angle with the line of centres increases. Hence as the number of teeth which the wheels contain is less, the greater must be the friction in impressing motion upon the driven wheel, because a greater angle is included in the space in which the one acts on the other.

I may observe to "S. Y." that if any farther demonstration was necessary, I could give him a diagram, with a specification, by which this matter might be rendered still more manifest, and that the proper application of epicycloids gives a true form to the teeth of wheels; but as the Editor appears to be so greatly pressed with matter from different correspondents (all of whom he is doubtless desirous of obliging), and has not yet been able to insert either the remainder of my answer to Mr. Wynn, or my reply to his anonymous correspondent, No. 314, p. 424, on the "Momentum of Falling Bodies," both of which have been handed to him some time ago, I shall forbear to trouble him with more matter until these are inserted.

JAMES HARRISON.

Barton-upon-Humber,
Dec. 30, 1829.

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

(Continued from page 343.)

The next subject to be entered upon is the consideration of machinery.

A machine is an instrument by means of which a force, of a determined quantity and direction, can be counterpoised, counteracted, or overcome by another force, whose quantity and direction are known.

Or, it may be described as a means of transmitting a force of a given quantity and direction from one point to another.

Again, it is a means of modifying the quantity and direction of forces.

A machine is employed for two purposes, either merely to sustain or absolutely to move a weight. First, if it is required to sustain a weight, the effect must be that equilibrium is to be produced. In sustaining a weight by a power, certain parts of the weight are thrown on certain fixed points: thus it is the fulcrum of a lever that supports both the weight and the power. It is a common opinion that a small weight can (by machinery) be made to balance a larger weight: but this is not true, for both the weight and the power are thrown upon the fulcrum; consequently the weight is balanced by the fulcrum and the power.

But if the machine be required to move or raise a weight, it is more difficult to explain. Suppose there was a block of stone weighing 20 cwt. to be raised by a weight of 1 cwt.: if the large block be divided into twenty smaller ones, it is evident that (each piece being equal to the small weight) the whole block could be raised by this small weight, taken separately. Now this is the exact use of a machine; viz. a contrivance for overcoming gradually what cannot be done altogether.

The present object is to examine the varieties of contrivances by which these effects are produced; but great as their number is, they may be all reduced to three classes, although they are often divided into six or seven.

The first class of machines comprehends a solid body, capable of turning

on a fixed axis. There are several varieties of this class; the most simple of which is the lever, as also the wheel and axle, the capstan and windlass, together with all combinations of wheel-work.

The second class is the rope or cord; this is commonly called the pulley: the objection to which word is, that the mechanical efficacy does not reside in the pulley but in the rope.

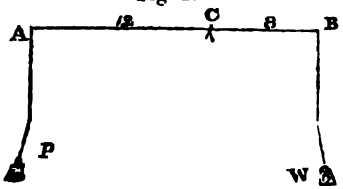
The third class is the inclined plane: this is susceptible of several varieties, such as the wedge, &c. as also the screw.

(It is to be observed, that all the principles of this science are grounded on false suppositions, but which are obliged to be admitted at present, in order to simplify the study. In the first place, there are several things, the effects of which are not taken into consideration; but which are never absent, as it is always (as yet) to be supposed that bodies move *without* friction, and that their surfaces are *perfectly* smooth. Again, solid bodies are supposed to be *perfectly* inflexible; also, that the cordage is *perfectly* flexible: that the machines are quite devoid of inertia; and, lastly, that they are free from the resistance of the atmosphere (all of which are false assumptions).

With regard to the first class of machines; the rule for determining the effect or efficacy of a force to turn a solid body round a fixed axis, is to multiply the force by its distance from that axis.

A simple lever is the most common form of this class of mechanical powers, and is an inflexible bar resting on a fixed point called the fulcrum, prop, or axis. The weight is whatever force the machine is applied to overcome, whether it be the turning a mill or any other thing. The power is the force applied to overcome the weight, whatever it may be. Let AB

Fig. 1.



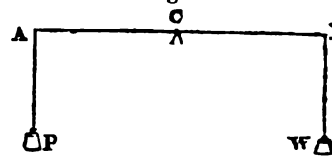
be the lever, resting on the fulcrum C; and let P represent the power, and W the weight. Now the same principles that were before given* will also apply here: for let P be equal to 4 lbs. acting at a distance (CA) of 12 from the fulcrum (the technical term for which distance is called its leverage), and let W be equal to 6 lbs. acting at a leverage (CB) of 8. The mechanical effect of the power is $4\times12=48$, but that of the weight is the same $6\times8=48$; therefore the power and weight are in equilibrium.

Thus it is evident that any weight, however great, may be balanced by any power, if ever so small, provided there be sufficient length of lever.

There are three different kinds of levers; the difference of which consists in having either of their three parts (viz. the fulcrum, the power, and the weight,) in the middle.

In a lever of the *first* kind, the *fulcrum* is in the middle, and the weight and the power are on opposite sides of it. This is the most common form, and is represented at fig. 2, where AB is the lever, resting on the fulcrum C; and P and W are the power and weight, acting on opposite sides.

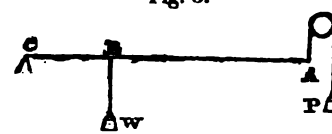
Fig. 2.



There are many familiar instances of this kind of lever; as a crowbar, a poker, also the handle of a pump. In this kind the prop has to support a weight equal to the sum of the power and weight.

When the *weight* is in the middle it is a lever of the *second* kind, as shown in fig. 3, where the letters refer

Fig. 3.



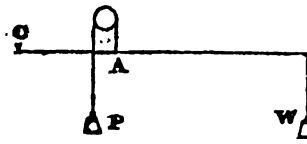
to the same parts as in the last. An oar is a lever of this kind; the water being the prop, the boat the weight,

* At page 175 of the "Mechanics Magazine."

and the effort exerted by the rower the power: a rudder is of this kind, as also a wheelbarrow. *

In levers of the *third* kind the *power* is in the middle. This is the most

Fig. 4.



unusual kind, for it is evident that the power acts to considerable mechanical disadvantage. It may be asked why it is ever used. It is never employed for merely supporting a weight, but only when velocity is required: for as much advantage is gained in velocity as is lost in power, or, as is the technical expression, what is lost in power is gained in velocity. The bones of animals are instances of this kind of lever: for example, in the part of the arm between the elbow and the hand, the elbow may be considered the fulcrum, and the hand, or what is carried in it, the weight; and the place (about an inch from the elbow) where the muscle acts on the arm, is the place on which the power acts. Now great velocity is gained by this arrangement; for, in a common-sized man, while the power moves one inch, the weight will move twenty inches. †

(To be continued.)

NEW BUILDING ACT.

Sir, — Perceiving that you have opened your pages for subjects which have a reference to the contemplated "New Building Act," and as I have been a constant reader of your valuable Magazine from the very first, perhaps you will have the kindness to allow a space in some early number for the accompanying paper, on which, allow me to add, I am most anxious to see the opinions of some of your ablest correspondents.

Yours, &c.

C. D. S.

On the necessity for and utility of a certificate of the kind and quality of the materials and workmanship of which houses are composed.

Perhaps it would be impossible to estimate the advantages to business if the houses in our public streets were always constructed on the most scientific principles—of the best, most durable, and, as far as possible, with fireproof materials. It must be a great injury to the trade, not only to the individual whose house is either destroyed by fire, or in consequence of its original bad materials and workmanship—either often requires repairs, or its becoming necessary to pull it down—but also to those persons in several houses on both sides. Certainly the rebuilding of a house in a public street is a public nuisance, although one which must be permitted; but if the frequency of such things can be diminished, it must be a public advantage.

Even the proper drainage, and the means of preventing smell therefrom, in every particular house, is of public utility, and no individual ought to be allowed to neglect it.

But, in endeavouring to show the necessity for a *certificate*, it may be observed in this place, that no restriction whatever is recommended either in the kind or quality of materials to be used, or manner of construction, except such as are manifestly dangerous either to the health, lives, or property of either the *inhabitants*, *neighbours*, or *passengers*.

Every building is composed of several kinds of materials; but when a house is finished, only the surfaces of a *very* few can be seen. The durability of a house depends on the nature, quality, and proper application of the materials. Some materials may be good of their kind, and in particular situations they would be durable; but in other situations they would very soon decay.

The stability of a house depends on the kind and quality of the materials, and on the method of construction and the workmanship.

Now, the foundations and drainage of a building may be very inadequate, the walls may be built with old or the very worst bricks, or other materials and mortar — the carpentry in the

* In this kind the pressure on the fulcrum is equal to the excess of the *power* over the *weight*.

† In this kind the *pressure* on the fulcrum is *the excess of the weight* over the *power*.

floors, partitions, and roof, may be of the very worst, or old timber, and these several parts may be constructed on the very worst principles—even the joiners and many other works may be of the most inferior materials and workmanship, and insufficient in substance; and yet when the several parts are cemented or plastered over, and their surfaces papered, coloured, or painted, and all clean, such a building will look as well to common observers as another, which has been substantially constructed with new and the best of materials, and in every respect containing the best workmanship. Indeed, it is not possible for any builder who did not attend to see the works in progress to form an *accurate* opinion either of the one built with good materials, or that which is built with the very worst, as, in both cases, the most important parts, when finished, cannot be seen.

It therefore follows that no just estimate can be formed of the quality or probable durability of either, or of the probable amount of repairs within a given time. From this circumstance, persons who purchase, or those who rent on repairing leases, are constantly subject to the greatest disappointments and impositions, for which they have no remedy: while the honest builder, who uses new and the best materials, well-seasoned, and constructs his house so as to ensure both stability and durability, has no chance whatever of obtaining either a reasonable price or rent. Indeed, it is in vain that he makes himself acquainted with the best materials for durability, or the best means of applying them. Of what avail is the experience of the ancients?

A purchaser or lessee of a house badly built soon finds that dilapidations occur, and all that can be done in the way of repairs will never make his dwelling substantial. He must therefore suffer the numerous inconveniences arising from an ill-constructed edifice, as long as he possesses it, even to the expiration of a 99 years' lease; if in the mean time he is not compelled to rebuild, or induced to sell at a considerable loss. *In the latter* case, it still remains a disgraceful monument to the dishonestly "speculating builder," and can never furnish any of that sort of satisfaction which a person may enjoy in a substantial dwelling.

In the case of a lessee, if he has undertaken to repair, and if he holds of a rapacious lessor, the latter will not fail to give him notice that he *must* "amend, support, &c.," agreeable to the covenants in the lease, and that too "in a good and workman-like manner."

Now if the house was never constructed of either good materials or workmanship, this is unreasonable: but the truth of this is perhaps seldom perceived until it is taught by experience.

There is no doubt, I think, that many thousands of persons are constantly suffering from some of the numerous ills arising from such deceptions. It is therefore thought a certificate of the kind, quality, method of construction, and strength or scantling of the several parts of a building (especially those materials which when a house is finished cannot be seen), would be a most desirable document.

Every respectable builder would, I think, no doubt, most readily approve of such a method of proving the difference between his houses and those of an inferior kind. Every person contemplating either to purchase or rent on a repairing lease, would be anxious to obtain an attested copy of the certificate, if one could be procured.

The nature of the property would thus be correctly known; and the lessee might have the probable extent of repairs estimated, while the ground-landlord might obtain from these documents a perfect knowledge of the quality of the houses on his estate.

There could not, in this case, be any misunderstanding between the landlord and tenant respecting the nature of the repairs at any period of the lease; and the works of the honest builder would have some chance of being duly appreciated.

It is true, a person may build a house without any intention of selling it. In that case it may be asked, of what use is a *certificate?* To that it

may be answered, the certificate can do no harm; and as it is not impossible but any house may at some time or other require to be sold, the certificate would then be of great value; and it would also be valuable to the inheritors of such property. In the event of alterations or additions being required, it might thus with certainty be known whether the old parts of the building were sufficiently substantial to warrant the contemplated improvements.

THE PORTABLE TRIGONOMETRY.

We have received a letter from "W.," a correspondent at Edinburgh, animadverting upon some parts of the communication of our correspondent, "P. M. W.," on portable trigonometry, No. 320. This letter we do not insert, because its author evidently misunderstands the drift of P. M. W.'s observations. P. M. W. is obviously too well acquainted with mathematics, and with the habits of practical mathematicians, to mean to imply, as W. supposes he does, that they were ignorant of the method of computing in trigonometry by the *natural* sines, tangents, &c. His remark appeared to us to amount simply to this—that it was extraordinary that theorists should endeavour to investigate approximations from series, &c., which, after all, are usually but gross and unsatisfactory, when the obvious employment of a table which only occupies *a single page* will accomplish the thing required, with the requisite accuracy for practical men. Our Edinburgh correspondent says, he is "quite ready to admit the utility of the principle developed in that article, and the value of its application, within certain limits." But he says a similar table is published by Professor Leslie in his "Rudiments of Geometry." This we presume, therefore, is the case. But does Mr. Leslie enforce the comparative utility of the method as P. M. W. has done? Supposing that to be the case—and we can only make a supposition, as we have not seen Professor Leslie's book—there still remains to the correspondent of the "Mechanics' Magazine," the praise, with which, if we can judge of his character from his communications, he will be very well satisfied, of putting practical men of circumscribed means in the way of obtaining for *sixpence* a table and rules, which in a volume would cost more than ten times the money.

CORRECTION OF A MATHEMATICAL SOLUTION, vol. IX. p. 157.

Sir,—In the "Mechanics' Magazine," vol. ix. p. 157, the following question is reproposed, viz.:—"Suppose I have a circular enclosure of an acre of ground, how long ought a cord to be that, fastened in the circumference of the enclosure as a centre, will strike an arch that will divide the said enclosure into two equal parts?" Answer, 45·47898 yards. Now, Sir, I beg leave to remark, that the above answer is incorrect, as it ought to be 45·48094 yards. The proportional length of the cord to the radius of the circle is as 1·15872846 to unity. In Leybourn's edition of "The Ladies' Diary," an answer is given by Mr. William Burdon, of Acaster Malbis, vol. iv. p. 8, deduced from a fluxional process, in answer to Question 964, vol. iii. p. 266. This gentleman makes the proportion as 1·1587167 to unity. Dr. Gregory states it as 1·15873 to unity ("The Ladies' Diary," vol. iv. p. 8.) From the above answer by Mr. Macgregor, the proportion comes out as 1·1586786 to unity. It will be seen, on comparing the above proportions with mine, that Mr. Burdon's is incorrect in the three last figures, and that of Mr. Macgregor in the four last figures. This question is only to be solved by the fluxional or differential calculus, or by approximation, and will not admit of a geometrical demonstration. My result was obtained by means of the differential calculus, and is, I believe, true to the nearest unit in the last figure.

I am, Sir, &c.

OMEGA.

REPORT FROM THE SELECT COMMITTEE ON THE LAW RELATIVE TO PATENTS FOR INVENTIONS—ORDERED BY THE HOUSE OF COMMONS TO BE PRINTED. 12TH JUNE, 1829.

The Select Committee appointed to inquire into the present state of the law and practice relative to the granting of patents for inventions, and to report their observations thereupon to the House, together with the minutes of the evidence taken before them, have agreed to the following Report:—

The subject referred to the consideration of your Committee is in its nature so intricate and important, that it has occasioned the necessity of examining witnesses at great length; at the present late period of the session they are only prepared to report the minutes of the evidence taken before them, together with several documents; and they earnestly recommend to the House that the inquiry may be resumed early in the next session.

MINUTES OF EVIDENCE.

8th May, 1829.

THOMAS BARRETT LENNARD, Esq.

in the Chair.

Mr. John Taylor, examined.—Considers the policy of rewarding inventors to be just and right, and that there can hardly be such a reward without some monopoly. The general objection to the present law is that *any publication* before sealing a patent vitiates the patent; whence arises a great difficulty in preparing a specification; the inventor is obliged to make his experiments without the assistance of others, and without such assistance it is impossible for him to make all those trials which would give him the best opportunity of describing faithfully to the public his invention, and any error he may make in his specification, however unintentional, completely vitiates his patent: this appears to witness one of the greatest difficulties of the present law. Thinks that were a commission, composed partly of lawyers and partly of scientific men, appointed for the purpose of examining, revising, and verifying specifications, so that no patent should be subsequently impeached upon the ground of inaccuracy in the specification, it would be very advantageous; provided the difficulty could be got over of appointing such a commission as would satisfy the public and inventors. Thinks that persons might be found to form a commission fully competent to decide on these points; but that perhaps a court of justice would after all be more satisfactory to the parties. As the law now stands the title of the patent must include the whole invention; hence every inventor tries to frame a title that will include every thing relative to his invention, and may in fact make it rather a delusive title. If a person includes in his specification a thing as new which has been previously discovered, the patent for the whole invention is void: thinks this a great hardship and injustice, and that it would be a benefit to the public if a plan were adopted by which a person should be allowed to retain a patent for that part which is new, making it void only for what is old. Conceives that if it were possible so to alter the law that that publicity which experiments may require should not vitiate a patent, it might be beneficial; for instance, that after giving notice, or taking out a caveat, the inventor should have a certain time allowed for making experiments, and that such experiments being known to people to whom he may be obliged to reveal his secret (workmen for example), should not afterwards vitiate his patent. Thinks it would be a great advantage to an inventor were power given to a commission to conceal a specification for a time, so that an invention might be made more complete; but doubts whether it would not be giving to a party applying to take out a patent too much protection against any improvement which might be made by others. Thinks there should be a difference between the time patents should run that are taken out for trifling inventions and more important ones, or such as involve great expense; at present there is but one period for all inventions, except when the period has been enlarged by special Act of Parliament. Is of opinion that when a person who has obtained a patent for an invention makes any improvement in it during the period for which he holds the patent, he should be at liberty to bring that improvement within the protection of his privilege, on lodging a description thereof, in order to its being made known to the public. Believes many

improvements are withheld from being published on account of the difficulty and expense of taking out a new patent. Thinks it would be desirable that a patentee should be required to carry his invention into effect within a limited period, or lose his patent. Is aware that it is a rule of law not to grant patents for abstract principles, but considers it an inconvenient rule; a person may not immediately have a technical mode of applying a principle, and a principle may be applied in half a dozen different ways. Thinks it very hard that from an imperfect plan a good principle should be lost; and believes that the prohibition to inventors to claim a patent on abstract principles often leads to an unnecessary multiplication of details in specifications, by which the public is really left in the dark as to what is the nature of the invention for which the patent is taken out. Is of opinion that the rule that there shall be only five persons named in a patent is an inconvenient one; because in many cases an inventor may not be able to raise a capital sufficient to carry his intention into effect, which might be done if a greater number of persons could be introduced to a share in the invention. Believes, however, that the rule is sometimes evaded by putting in names under licenses, or as trustees for others: as the law now stands, the person applying for a patent must swear either that he is himself the inventor, or that the invention has been communicated to him by a foreigner residing abroad, and no British subject can take out a patent for an invention communicated to him by another British subject; but witness sees no policy at all in this distinction between the communications of foreigners and natives, and has not the least doubt that it is often the cause of patentees perjuring themselves. Considers the expense of a patent a great objection; also the difficulty of maintaining it in courts of law. Does not conceive that the present expense is necessary to check frivolous applications, or that it does serve to check them: the defence of the patent is one of the most expensive kinds of defences, on account of the sort of witnesses that are generally necessary; it has become the fashion of late to subpœna a number of eminent scientific men, some perhaps brought from a great distance. The expense of defending a patent has now become enormously great.

Questions on patents are sometimes tried *by special juries*; do you know whether any inconvenience arises from that sort of tribunal? It is difficult to get counsel to explain a case properly to the jury, and to get their attention excited to the inquiry; it is very difficult to explain even to gentlemen who have more attended to this kind of subject, and requires most expensive models to be made; it is very often exceedingly difficult to make even the judges understand.

Do you not think it would be better if a commission could be formed of scientific men, who are accustomed to the thing; that it would be a much cheaper and better mode?—I think it would be a better mode, as it would avoid all that immense train of scientific witnesses often conflicting with each other, which adds so much to the expense.

Do you think that a tribunal of scientific persons would be a purer tribunal than that composed of persons indiscriminately chosen? I do not think it would be a purer tribunal, but I think it would be as good a tribunal, and might be much cheaper.

Do you not think that it would be much purer and more competent?—I think it would be as pure.

Do you imagine confidence would be placed in such a tribunal?—I dare say there would be jealousy; I do not mean to say a commission would be quite satisfactory.

If a commission were appointed must there be a commission for each case separately?—I should think there must; a commission might be something in the way of arbitration.

Do you not imagine that in consequence of the expense and difficulty of defending patents there are successful attempts at infringement in many cases; I should think so: the case of the Kaleidoscope, for instance; it would have been quite impossible to have defended that patent; they must have brought five hundred actions.

Davies Gilbert, Esq., a Member of the Committee, examined.

What is your opinion of the policy of the present law in granting patents upon abstract principles?—I conceive that the invention of a principle is a much greater achievement, and much more likely to produce great public benefits than the invention of any mode of applying a principle already known; I therefore think that *a fortiori* there should be protection given and encouragement held out to the discoverers of new principles, and that they should be

secured to the inventor for the legal number of years; but always assuming that some practical mode of applying them to useful purposes make a part of his invention, and is included in the specification; and then I think that the inventor should not lose the benefit of his temporary monopoly in consequence of another or even a better mode of application being discovered.

What is your opinion of the expediency of appointing a commission composed of scientific men and lawyers, to examine a specification before it is enrolled to ensure the patentee from having his patent afterwards impugned?—I think it would be highly expedient that some person or persons more competent to judge of scientific matters and inventions than Attorney-Generals, from the course of their ordinary pursuits are in general to be found, should be called to his assistance; but I would not preclude either party from any subsequent legal remedy he may choose to adopt.

You would not have a commission then to inquire whether the specification really agreed with the invention or not?—So far as it went to guide the opinion of the Attorney-General as to granting patents at all, and to whom they should be granted, I think it would be highly useful; but I entirely dissent from any opinion which would give authority to such decisions, so as to preclude persons from recovering afterwards in a court of law.

What is your opinion of the policy of the law which vitiates a patent, if one feature of the invention, described in the specification, is proved to have been known before the sealing of the patent?—I think it is inexpedient, unless fraud can be proved.

Do you think a tribunal of scientific men would better decide the validity of a patent than if it was tried by a court of justice?—It must frequently happen in a court of law that neither the counsel nor the jury are qualified, by their previous knowledge, to decide on such cases; and consequently men of general science, acquainted with the subjects in dispute, must be more competent to forming accurate judgments respecting them; but I am not aware how a tribunal of such persons could be formed, unless it was done through the medium of a reference—the definition of a man of science would seem to be a matter of no small difficulty.

Do you think it would be convenient *to have* a commission of scientific men *and not* a jury?—I think they would be more competent to decide; but public opinion would probably not be so confident of their exemption from bias, from *esprit de corps*, perhaps from influence, as in the case of our ordinary tribunals.

Mr. Gilbert further stated it to be his opinion, that it should be lawful for a person to take out a patent for an invention communicated to him by a British subject, provided that it appeared the communication was voluntary, and that it would be advantageous to allow individuals to secure a monopoly of less than fourteen years on paying diminished fees.

11th May, 1829.

Mr. John Farey, Engineer, examined.

States, that he has had considerable experience in the practice of taking out letters-patent, and assisting inventors to support their patent-rights at law when disputed. That the expense of a patent for England amounts to 120*l.*, for Scotland 100*l.*, for Ireland more than 125*l.*, and that there is a small addition if the patent includes the Colonies; that these sums include an *average* of engrossing and stamps for the specifications; the charge varying with the length of the specification. That there are further charges depending on the difficulty of preparing the specification, which are not included in the above sums, and which in one case of a very intricate invention, where there were patents for all the three kingdoms, amounted to about 200*l.* That when it is desired to extend a patent to one of the Colonies, it requires an express act of the colonial legislature, to enable disputes, on the patent-right to be tried in a colonial court of justice, otherwise they would have to be judged here, which would increase the expense of law-proceedings beyond all bounds. That the time required to obtain a patent is said to be six weeks; but whether they have ever been obtained in six weeks or not, witness cannot say; they are certainly now two months upon the average, and that is frequently extended to a much longer period. That during the time between making the application and sealing the patent the applicant has no security whatever for his invention; there is even an increased necessity for secrecy beyond that which existed before his application, because his application has called attention to his proceedings, and declared what is the object of his pursuit. A man who has proceeded with some freedom in his experiments, and

in private trials of machinery, before he applies for his patent, is always obliged to shut up his models, and desist altogether, until he obtains a patent: for by his application he calls the attention of all rivals to his proceedings; and any disclosure of his invention made before his patent is sealed, (however treacherously obtained), would be fatal to his patent. It is a common practice of manufacturers, if they begin an invention solely for their own use, without any thought of a patent, when they have obtained such a prospect of advantageous result as to see that a patent would be desirable, they destroy all the models, and every vestige of them, and even send away the workmen who made them on some distant embassy, to avoid any chance of the secret being called forth by the competition that exists among rival traders as soon as one makes an application for a patent: that this is a very great inconvenience, and the cause of much valuable time being lost to the public as well as to inventors. That it frequently happens that patents are delayed very long in their progress through the offices, so as to occasion a very great grievance. That opposition often grows up in the meantime, which the applicant is obliged to meet at considerable expense, and at the risk of still further delay being occasioned. That titles are often worded obscurely, in order to avoid directing public attention to the subject; but that there is a danger in being too obscure, because then a court of justice may afterwards hold that it is an invalid patent for want of coincidence between the title and the specification. That the remedy for this is obvious; namely, to make the right of the patentee secure from the time he makes his application, on condition of his lodging a paper of the heads of his invention, as is the case in Spain; or that the final specification and description of the means of executing the invention should be engrossed in the patent itself, so that the title of the patent instead of being the only means of reference between the two documents, should become a mere indorsement, and a matter of no importance, as is done in France. That as our practice is now, if the judges cannot find in the title of the patent what has been called a general index of the specification, the whole patent is set aside; but that the difficulty of making a correct general index to a work not yet composed is necessarily very great. That it has *never been decided* with precision what constitutes such a publication as should vitiate a patent; but witness infers from the concurrent opinions of counsel of eminence, that even the divulging of an invention by a person to whom it had been confidentially intrusted, would be held to have such an effect, though of course the inventor would have a remedy against the betrayer of his secret by action for damages. Witness has a confused recollection of a case between Finch and Dickenson, in 1803, when a person who had committed a breach of trust of this kind, and taken out a patent in his own name instead of for the joint benefit of both parties, was cast in 300*l.* damages, and ordered to resign the patent to the plaintiff. That it has been decided that if a person has made an invention of the same nature as that for which a patent is sought, and has carried it on secretly, this secret exercise of the invention will not preclude the applicant from taking out the patent; but then if the person so carrying it on secretly should make it public, in the interim between the application for the patent and the date of the patent, that will render the patent nugatory. That the public have no means of becoming acquainted with the fact, that an application for a patent has been made before the patent is sealed; but that individuals may obtain information of all applications for patents in regard to any particular matter in which they are interested, by lodging a caveat at any of the offices through which patents are expedited. That to a person intending to apply for a patent, a caveat is only of use in the case of his having disclosed his intention to some agent, or associate, or patron; and having reason to suspect that such person may apply for a patent himself before the inventor is ready with his application, by lodging a caveat he will have notice of and detect the treachery before it is too late. That in general, however, the lodging of a caveat by a person intending to take out a patent is a bad measure, from its calling attention to the inventor's proceedings. That in the case of two applications for a similar invention, the rule, according to witness's impression, is to give the first applicant the preference, providing always that each has invented independently of the other; but in such cases it is usual for the Attorney-General to recommend to the parties to combine their interests, because it is in the power of the latest applicant, by a previous public disclosure of the invention, to render nugatory any patent that

may be granted to his rival. That in all such cases of rival applicants, the Attorney-General is the sole judge, nor does he ever call in any assistant by way of assessor. That it is not felt in practice to be an inconvenience that such a power should be lodged with a person not very competent to decide scientific questions, because the Attorney-General almost always sees sufficient ground of new invention to grant both patents. That oppositions are of no effect; and the result is, that a man can get a patent for any thing, unless it be a notoriously old invention, and even then very slight alterations will make it appear new to a person unacquainted with inventions. That an opposition is in truth a mere formality; and that if any of the Attorneys'-General witness has attended (unless the present Lord Chancellor might be excepted) had attempted to exercise a judgment between contending inventors, it would have been very mischievous in many cases, and never productive of any good—patents being at all times subject to be annulled by a court of justice. That the Attorney-General almost uniformly recommends the King to grant a patent; and when there are two applications for similar inventions allows both patents to pass, though there might be a chance on a very close inquiry by competent judges of finding a collision. That it is only in the case of an opposition that an applicant for a patent is obliged to give a general description of the nature of his invention to the Attorney-General; and in witness's opinion, it is a great evil that applicant is not in every case fixed to what he does intend to specify. That there are speculators or patent jobbers who, the instant they find out that a person of talent is occupied with an invention; apply for a patent with a title sufficiently general to cover the invention; and having thus got the start of the inventor, if they can by any means get at the invention before the time of specifying, they have a good chance of making it their own: for even if the real inventor gets notice, and makes opposition, he is the second applicant, and is almost always obliged to make it a joint property; because, unless he can prove the fact of the plagiarism, the Attorney-General can rarely be convinced of the identity of the same invention, when differently explained by two parties, with different models or drawings. That a patent was granted (to Colonel D'Arcy) on the 29th November, 1828, but not yet specified, intituled, "For certain improvements in the construction of steam-engines, and the apparatus connected therewith;" and the patent gives 18 months to prepare the specification: now whatever that patentee can find out by any means in the course of the 18 months he may bring forward in the specification, and nobody can prove that he did not possess the invention at the time of his application. That it would, in the opinion of witness, be advisable that the applicant for a patent should lodge a kind of temporary specification of the principles of his invention, as is done in Spain, and be secured against the effect of treacherous or rival publications of the same invention before the sealing of his patent. That the practice in France and America is to require a complete specification in the first instance, but this witness would not recommend; he would propose that there should be only a temporary specification in the first instance, containing a definition of the principle and object of the invention, leaving the applicant afterwards to prepare a more complete specification when he had organised and proved the means by which the invention is to be carried into effect; and that such final specification should only include such matters as are in the opinion of competent examiners a fair extension of the statement of the original idea, as expressed in the temporary specification first deposited. That as matters now are, a patentee is not obliged in any way to declare what his invention is till he puts his specification to the patent previously granted to him, and in the mean time he may change his plan within all the latitude that the generality of the title will permit. That there is no legal limitation to the time allowed for lodging a specification after the issuing of a patent, and that it is quite discretionary with the Attorney-General how long time shall be allowed; but that the custom is to allow in the case of a patent for England alone two months; in the case of England and Scotland four months; and where the patent is for the three kingdoms six months. That some ten or fifteen years ago there were several patents granted with eighteen months to specify; but that great complaints being made of the practice, it was put a stop to by Lord Eldon, and that there have been none till the recent instance before-mentioned. That though it is essential to allow a long time for getting sufficient specifications made of important inventions, yet on the other hand it is an excessive grievance to pa-

sons engaged in like pursuits when there is no provisionary definition of the legal right conferred by a patent made public. That it is the practice in all other countries to allow patents to be taken out for long or short periods, at the option of the patentee, and to diminish the expense in proportion to the limitation in the time; but that the adoption of such a plan in this country would not in the judgment of witness be advantageous, because patents for profitable objects would always be taken for the longer term, unprofitable ones become extinct of themselves; and were patents made cheaper, it would tend to multiply the number of patents for trivial inventions. That it often happens that after a person has taken out a patent for an invention, and lodged his specification, he makes some material improvement which makes it necessary for him to take out a new patent; but that witness would recommend the adoption of the practice followed in France, where, as improvements arise, successive specifications of these improvements can be added at a small expense. That the French mode enables a patentee to give validity to his patent, even though in the first instance it may have been defective, while with us there is no remedy whatever for a defective specification, excepting taking out a new patent. That the English remedy for a bad specification is merely penal—the patent is held to be invalid; but that the public have no advantage from this whatever—they do not get any more complete specification by annulling the patent. If a patentee were compelled to bring a better specification there would be a real advantage; and if he refused to do so, then the present penalty of forfeiture would be very properly applied.

Do you think that the public would have any security against such imperfect specifications by the appointment of a commission to examine the specification before it was enrolled?—It would be very easy to have specifications examined and verified either by a competent commission, or by suitable referees. The courts of justice now trust to the examination and opinion of others, but they do it in an improper manner, because it is by parties brought by interested individuals, and when it is too late to amend any defects. I think that the final specification ought not to be enrolled at all till it is made sufficient. A commission well constituted would determine that and many other *points very well; but I* think it would be very objectionable that any previous examination should take place as to the *merit* of inventions, because it is impossible to foresee which will by future cultivation grow up to maturity, and which not; every one should be allowed a fair chance.

You would propose to secure to the applicant from the time of his application his right to the principle of his invention?—Yes, to the invention of which he details the heads; and all such fair developement of these heads as he is prepared to specify completely how to practise them, at the time when his (final) specification is due, or with such extension of that time as is reasonable.

So that before his patent is issued he should be required to enrol his specification?—Yes, in order that the specification may be transcribed in the patent itself, having been first approved to be sufficient.

By a record of the heads of an invention, could you so secure to the applicant his invention as to leave him at sufficient liberty to pursue his invention for the purpose of making a complete specification?—I think he ought to be bound to be able to define his principle very accurately at his first application, because he ought not to be allowed even to apply for a patent when his invention is a mere vision; he ought not to come until he has done all that can be done mentally by himself and by projection on paper, so as to be fully prepared to state all the principles or heads of his invention, leaving nothing remaining to be done but what requires to be decided by experiment.

Will you instance in the case of Mr. Watt's improvement in the steam-engine the proposals which you suggest for the improvement of the process in obtaining a patent?—I think that the deed which Mr. Watt enrolled for his specification ought to have been lodged at the time of making the first application for his patent, and he should have been allowed at least two years for making engines and the experiments necessary for specifying the means by which those principles should be carried into execution; within that two years he should have made such a specification as would have really instructed competent workmen how to practice the invention, whereas that knowledge never came before the public from Mr. Watt till long after his patent was dated, and then only incidentally, not by the operation of the law.

Could Mr. Watt have made that statement of heads of invention without previous experiment?—Yes, at the time he drew up those heads (which I say are not specific enough to be a specification), he really had made no engine, and only a private experiment by himself with a very incomplete model—not a working model.

Would a specification of those heads have secured him against any rivalry?—They did so in fact most completely for thirty years: his paper was admirably well drawn, and very definite; but in allowing these heads to pass for a complete specification, a latitude was given to Mr. Watt, in favour of his great services, which the courts have never allowed in any other case, because they took it for granted, on very insufficient evidence, that they were sufficient directions to enable other persons to practice the inventions, but they are not so in fact; and upon the grounds on which the courts have proceeded in all other cases, they should have annulled that patent for want of sufficient description in the specification.

Then he gave in for a complete specification that which according to your ideas ought to have been given in the first instance?—Exactly so; and he never did give any complete specification, such as I think ought to have been given, in the second instance. The consequences of that omission have been important in his case; for long after the expiration of his patent, which was prolonged and kept in force in the whole for more than thirty years, engineers who wanted to make steam-engines had to go and steal a knowledge of his invention from his factory, or from examining engines made by him, with as much difficulty as if he never had a patent; going to the office and reading the specification did not answer the purpose at all. It was not till twenty years after the expiration of Mr. Watt's patent (which was fifty years after its commencement), that any number of the many manufacturers of steam-engines in England understood how to make them perform with the same perfection that they were made by Mr. Watt himself, within ten or twelve years after his patent, and as he ought to have instructed the public by a specification as soon as he could have done so.

Do you consider that the term of *14 years* is sufficient in all cases?—*By no means*; fourteen years' *profitable exercise* of an invention is certainly *sufficient*: the question is when that profitable exercise will begin, and how much previous loss and outlay is to be made up; in some instances it begins from the first; in many instances it does not take place at all during the term of fourteen years.

Can you give an instance of the oppressive operation of the law in this respect?—Many. Mr. Woolf's invention (of working steam-engines by high-pressure steam acting expansively, either in one or two cylinders); he carried on business to a loss for at least ten years, and though he made a profit in the last four years of his patent, it did not compensate the loss during the first period. The extension since given to that invention is so important, that the existence of deep-mining in Cornwall at this moment depends upon it. The difference in cost between the quantity of coals consumed by the engines now in use (which are all on Mr. Woolf's system), and by an equal force of engines, such as were in use before he went into Cornwall in 1813, would absorb the profit of all the deep-mining that is now carried on in Cornwall. I think Mr. Woolf is more entitled to a public reward for the services he has rendered without any recompense, than any inventor who has ever been rewarded by Parliament. Mr. Crosley, whose bill (for an extension of Clegg's gas-meter patent, assigned to him,) has just been withdrawn, is another example; and Mr. Eaton, who invented the self-acting mule to put up by power. The establishment and consequent profitable exercise of many inventions when made complete, is often retarded and prevented by public prejudice and ignorance of their true value; also by the opposition of work-people, and the fear that they may mutiny in establishments where new inventions are first practised. I could give many instances of such cases. Mr. Eaton's is a strong one; the few machines that he made when I prepared his specification ten years ago have continued in profitable use ever since, but no more can be introduced.

Mr. Farey being further examined, stated—That in France specifications are always kept secret during the term of the patent, and even afterwards when the government decide that it is advisable to do so, but that in this country the specification can only be kept secret by express Act of Parliament, which is commonly granted on the ground that the invention shall not get away to foreigners; but that in the opinion of witness, it is always improper there should be a secret specification under

any circumstances whatever, since even, as a means of keeping our inventions from foreigners, such secrecy only acts as a premium to inventors and their workmen to go abroad, and turn their secret knowledge to a profitable account in foreign parts. That the rule of law by which a want of originality in a single minor point of a patent vitiates the whole, is a most excessive hardship and injustice, and every way impolitic. The reason for it is that so long as patents are granted merely upon the request of the inventors, and whilst they are left at liberty to specify what they please, if there were not some limiting penalty of that sort, they would put inventions *ad infinitum* into their specifications, for the chance that if one hook did not catch another might; but the proper remedy for that evil would be to set aside that part only which is not original. That there appears to the witness to be no advantage in the law which allows a person to take out a patent for an invention communicated to him by a foreigner, and not allowing him to take out a patent for an invention communicated to him by a British subject; except inasmuch as the contrary might tend to be a premium to the fraudulent obtaining of inventions. When an invention is fairly assigned, there can be no reason whatever why a patent should not be taken out by the assignee; in many cases it would be attended with great advantage, because it constantly happens that the inventor is not so well qualified to pursue his invention into actual practice as some other person, who for that very reason would become the purchaser if encouraged by law.

Since a patent for the three kingdoms costs from 400*l.* to 500*l.*, does not that operate as a tax upon different inventions with great inequality?—The expense of the patents for the three kingdoms is decidedly too high; but I don't think that the present expense of a patent for one kingdom is too high. I think that the present expense of a patent for England would be about the proper expense of a patent for the whole of the British dominions. I mean that, in the absence of any other check to an unlimited multiplication of patents, they should not be granted too cheaply.

Does any method occur to you of having the cost of a patent made proportionate to the importance of the patent?—Possibly it might be desirable to make little or no expense in the first instance, but to apply an annual and *increasing tax upon the* continuance of the patent-right—to make the tax scarcely any thing at first, but to establish such a progressive increase from year to year as would at last induce inventors to abandon the right before the end of the term, which in that case should be longer than at present (say 21 years).

15th May, 1829.

Arthur Aikin, Esq. examined.

Submits the following as a short statement of the proceedings which he thinks ought to be had in taking out a patent. It should commence by a petition to the Attorney-General, stating that the petitioner has made an invention likely to be of public utility (and the general nature of the invention should be here rehearsed), and that he wished to have a patent for such invention; also, that he be allowed time previous to specifying to make experiments, and that while such experiments are going on no one should be allowed to anticipate him by taking out a patent for the same. This petition should be put by the Attorney-General into the hands of examiners, in order to ascertain whether the petitioner's invention has already formed the subject of a patent: if it has not, the prayer of the petitioner should be granted, and he should be allowed from three to nine, or perhaps twelve months, for making his experiments; subject, however, to an obligation either of specifying at the end of that time, or of forfeiting a certain sum. The petitioner having made his experiments, should then proceed to specify, by delivering into the examiners a full account of his process, with the necessary drawings, declaring that the same is a full and true statement. The examiners should then call on the petitioner to perform his process before them, comparing the process with the written description of it, and requiring the petitioner to correct his description where defective or erroneous. Such corrected statement should be certified by the examiners, and handed over to a law-officer to put it into the form of a legal specification. Such specification should then be compared by the examiners with their certified description, and if found correct should then be enrolled. The specification should remain sealed till the end of the monopoly granted by the patent, and should not be opened except by an order of the court, in case the validity of the patent comes to be contested; but the patent should not be set aside for any error in the legal form, or error

in dates, or clerical mistakes. If the patentee, during the first seven years of his term, practises any variation from the process or apparatus described in his specification, he should be bound previously to lodge with the examiners a description of such variation, on pain of the patent being void. These variations should form part of the patent, and the monopoly of them should cease with the patent. But the patentee should be allowed during the last seven years of his term to work his patent with any improvements, without being obliged to communicate them to the examiners. With regard to fees witness would be inclined to levy a small one on the petition, reserving the principal payment for the enrolment of the specification. Many inventions are made by persons by whom a large fee in the first instance can not be afforded; and monied-men would be more disposed to advance the necessary funds, after it had been ascertained by an experiment performed upon a large scale that the invention was likely to answer in practice. Witness would make the Attorney-General the judge of the length of time to be allowed between the petition for the patent and the enrolment of the specification; and thinks the Attorney-General should have the appointment of the proposed examiners. By having the specification sealed, he means that it ought to be open only in case of requisition from a court of justice, and not open for general inspection till the end of the term: but admits that there are great difficulties in the case. On the one hand, there is a great deal of annoyance that the patentee is liable to from fraudulent attempts to come as near his patent as possible without actually infringing it; and on the other hand, there is also an objection which has been stated on the part of persons *bona-fide* making improvements, and finding, after they have been at the expense of setting up apparatus, that they are prevented from using them by patents already taken out. These are two difficulties which oppose one another, and witness does not see how it is possible to get completely clear of both of them. Thinks the public would gain a great deal by a previous examination of specifications by persons properly qualified; because if you examine those patents that have expired, many of them cannot be worked at all, because the patentees, either from negligence or from fraud, have omitted *stating* particulars, which (although not *obvious* to a person reading over the specification) are found of great importance in endeavouring to carry the invention into effect. Supposing a commission or assessors to be appointed, witness would not have them responsible for any of the legal language of the specification, because it rarely happens that you can obtain in one person the necessary combination of legal and scientific knowledge. The duty he would impose on the examiners would be only that of seeing that the statement made by the patentee corresponds with the process as brought into practice: witness would then leave to other persons the obligation of putting it into legal form, and then he thinks in equity the patentee ought to be secured from any risk of his patent being overthrown upon a mere legal technical objection. With respect to the present rule of law that a patent cannot be given for a principle, witness decidedly approves of it; no patent should be granted for a mere principle without some practical application of it.

Mr. Mark Isamberd Brunel, Engineer, examined.

Has taken out several patents, but knows very little of the patent-laws: thinks that if patents were very cheap, there would be the more obstacles in the way of good ones—that the expense should be pretty high in this country, because if it is low you would have hundreds of patents more yearly, and would obstruct very much the valuable pursuits: considers the present cost, however, too dear. Is of opinion, that a commission to examine specifications would be a very good thing, especially if such commission had power to give inventor a year or two to improve his machine. Considers the present rule of law that patents cannot be taken out for an abstract principle by no means an unwise one, and that it ought to remain as it is. A principle without a mode of carrying it into effect is of no use whatever; it may remain ages, as steam has remained ages, unused.—Would in some cases increase the period of a patent beyond fourteen years, and allow of patents being taken out for a shorter term at a smaller expense. Conceives that there would be very great objections to a commission for the regulation of patents, arising from the jealousies that would subsist; but thinks so ill of the present mode of trying the validity of a patent by a jury, that he has frequently said he might as well toss for the fate of a patent: it is an intricate question for a jury, and in

many cases it is quite unintelligible for them.

What are the prices of patents in France?—I think it is 1500 francs for 14 years.

Do you consider that too low a price?—For France it is very well, but for this country it would be too low.

What would be your opinion of giving a power to the Secretary of State, or some other authority, to direct the specification to be cancelled in certain cases?—I do not know what is the motive for cancelling it: if it is on behalf of the inventor, that is some reason; but if it is to prevent its going abroad, it is of no use; because if it is good it will soon make its way, and if it is not it is of no consequence.

Is not that the mode adopted in France?—It is; but it is not that liberal principle which exists in this country.

Mr. Charles Few, Solicitor, examined.

Has taken out several patents, and entirely concurs with Mr. Aikin on the efficacy and propriety of a commission, instead of the present mode of proceeding before the Attorney-General, which is little better than a farce; but differs from Mr. Aikin thus far, that he would allow every person who chooses to take the risk and expense to have a patent, in case no caveat is entered against him, and would only have recourse to a commission in case of a disputed patent: which commission should be formed of scientific and practical men, with the Attorney-General, or some other barrister, at its head. Would not have the validity of a patent tried by a jury, as they frequently can know nothing about what they try. Does not agree with Mr. Aikin as to the expense of a patent being small;* but thinks it should be a pretty heavy sum. Would increase the fee upon patents!! Would have it such a sum as would pay the commissioners!!! Is quite satisfied that great inconvenience would result from considerably reducing the present expense of patents, because, even at the present expense, there are so many trifling patents taken out. If the fee was much higher, parties that are now taking out patents for little speculative things that do not answer would not take them out. But admits, at the same time, that he can see no reason why one patent should not serve for the whole of the three kingdoms, except that there are fees belonging to the different Secretaries of State of England, Ireland, and Scotland, who MUST *be provided for*, SOME HOW OR OTHER!!!!

18th May, 1829.

Mr. Francis Abbott, of the Petty Bag Office, and Solicitor, examined.

Stated the process of taking out a patent for England. It is sometimes usual, although not necessary, to enter a caveat as the first step, as a precaution that the applicant shall not be anticipated (as has sometimes happened) by some other party, in taking out a patent for a thing which he has invented. After entering the caveat, or without entering the caveat, an affidavit is made by the person, that he has either invented, or has had communicated to him by a foreigner, some discovery. A petition is then presented to the King, praying a grant of letters-patent for England, Wales, and Berwick-on Tweed, or with the addition of the Colonies; the colonies are frequently omitted, because it is attended with some extra expense, and in many inventions it would be of no use to embrace the colonies. That petition being submitted to the Secretary of State, a reference is made to the Attorney or to the Solicitor-General, who reports in favour of the application, if it is not stopped by any caveats; his clerk looks over the books, and if he finds any caveats for a patent on the same subjects, the applicant is delayed a week, that notice may be given to those who have entered caveats to decide whether they will oppose it or not; if within that week the person having had notice says he shall oppose, the next step is to take out a summons for the hearing before the Attorney or Solicitor-General. A week's notice more is given of that appointed time; but frequently the parties who have said they should oppose do not oppose: instances have arisen where patentees have been brought some hundreds of miles to support their application, and when arrived, no opposing party has appeared. If the parties attend, they are heard before the Attorney or Solicitor-General, and if he sees any reason to think there is an interference, he stops the patent; if he thinks there is no interference, he makes his report in favour of the application. That report is taken back to the Secretary of State's Office, for what is called the King's warrant; that warrant recites, shortly, that such a person has applied for a patent, and

* Mr. Aikin seems only to have proposed that it should be small *in the first instance*.—EDIT. M. M.

that the King is advised to grant it; and he, in general terms, directs the Attorney-General to prepare a patent for the King's signature. The warrant, as it is called, is then taken back to what is called the Patent Bill Office; it is still under the Attorney and Solicitor-General, in an office exclusively appropriated to the engrossing of patent bills. In the course of a week, or sometimes more, the bill is prepared and signed by the Attorney or Solicitor-General, and taken back for the King's signature to it, and is then called "The King's Bill;" the King having signed, it goes to the Signet Office, where it passes, and then it is called "The Signet Bill;" from thence it goes to another office, where it undergoes the Privy Seal, when it is called "The Privy Seal Bill;" from the Privy Seal it goes direct to the Lord Chancellor's Office, and receives the Great Seal. Originally it used to pass another stage to the Hanaper, to pay the Hanaper fees on it; but it is not now taken to the Hanaper Office, the clerk of the patents at the Great Seal receiving the Hanaper fees, and paying them over. If there be no caveat, the Great Seal is affixed; but if there is a caveat, notice is given; and if the party says he opposes, then the applicant has no means of getting rid of that caveat but by a petition to the Lord Chancellor, which, in modern times, is very rare. When witness first began to pass patents, caveats in this last stage were much more frequent, because, at that time, they were vexatiously resorted to in many instances, it being considered that the Lord Chancellor had no power to award expenses, however improper the opposition; but, about thirty years ago, after mooting the question several times before the Lord Chancellor, on a petition witness presented, the expenses were ordered to be paid by the person who had either not sufficient grounds, or did not appear to support them; and, since it has been found that the expenses can be awarded at the Great Seal, the oppositions there are much less frequent. When a person has thus completed a patent for England, he must go through nearly a similar process to obtain one for Ireland, and so also for Scotland. The Scotch patent passes a seal that is called a "substitution for the Great Seal of Scotland," at Edinburgh; and the Irish patent passes the Great Seal at Dublin; the English one, the Great Seal here—all three separate and distinct jurisdictions. Nearly the same expenses, too, are incurred in each case. The time required to obtain the Great Seal to English patents depends much upon casualties; they used to be more expeditiously obtained than at present: now we are, sometimes, three months or more in getting a patent. An Irish patent can seldom be got in less than five or six months; it is the more unaccountable, since the royal signature is only required once for Irish and Scotch patents, and twice for an English one. Every body who has had any thing to do in the business, have felt the great inconvenience of this. Witness frequently urged the danger of having the Irish patentee's right destroyed, inasmuch as any body may see his English specification here on paying the office-fees, and by sending over to Ireland the whole subject-matter of it, and publishing it there before his Irish patent has passed the Great Seal, renders it completely nugatory. The greatest delay arises when the royal signature cannot be obtained. Witness can get a Scotch patent, although he has to correspond with his agent in Edinburgh, much more expeditiously than he can an English one; in ordinary cases, about half the time; because the King's signature is only required once: as soon as the Lord Advocate of Scotland has made his report, similar to the Attorney-General's report in England, the King issues a warrant, as it is called, which is a substitution for the King's bill here; it differs a little in form. The introduction of the Scotch form here would be a very great improvement. The expense of a patent is increased if taken out by several persons. The following statement shows:—

SIGNET OFFICE.	One Name.			Two Names.		
	£	s.	d.	£	s.	d.
Fees and Stamps	3	1	0	7	13	0
Gratuity	1	1	0	2	2	0
Receiver and Assistant Clerk	0	5	0	0	10	6
	£4	7	0	£10	5	6

PRIVY SEAL OFFICE.	One Name. £ s. d.	Two Names. £ s. d.
Fees and Stamps	2 16 0	7 8 0
Gratuity	1 1 0	2 2 0
Record Keeper	0 5 0	0 10 6
	£4 2 0	£10 0 0

The expense is also increased before the Great Seal—the Chancellor, two pounds odd; and there is an extra fee at the Hanaper, which is received by the patent clerk at the Great Seal Office.

When an infringement of a patent takes place, the mode pursued by the patentee of preventing that infringement continuing is, by an application to the Court of Chancery for an injunction; but the injunction is always dissolved upon the application of the other party to try it; and the defence of a patent is one of the most expensive kinds of defences, on account of the kind of witnesses that are generally necessary; it has become the fashion of late to subpœna a number of eminent scientific men, some, perhaps, brought from a great distance. The expense of defending a patent has now become enormously great.

States, in answer to further interrogatories, that it would be highly desirable if any means could be devised by which the applicant for a patent should be protected from the moment he applies for his patent; but though he has thought a great deal about the matter, has not been able to arrive at the conclusion that it would, on the whole, be beneficial to make a person enrol his specification immediately on his applying for or obtaining his patent. If his preliminary description of his invention is to be of any utility, it ought to be complete; for if a man is left to enlarge or contract it, you leave an open door to all the mischief you are attempting to guard against. Should hesitate much before he would say that a commission of scientific men to determine between rival applicants, or to judge of the sufficiency of the specifications, would be considered satisfactory: thinks it would be attended with great danger to patentees, and productive of favouritism. The Attorney-General has it in his power now to call in the aid of scientific men when he thinks it necessary; has known Sir Thomas Plumer do so.

22d May, 1829.

Mr. Abbott, being again examined, states, that specifications may be enrolled at any one of the three different offices—the Petty Bag Office, the Rolls' Chapel Office, and the Inrolment Office; and thinks it a great grievance that a person has no means of knowing in what office any patent of which he is in search is enrolled, particularly as he has to pay separate fees of search at each office. That extracts or specifications are not permitted to be made; they are only to be allowed to be perused. That the present practice of requiring separate patents for the three kingdoms appears to witness to be attended with no advantage, but, on the contrary, to be a source of very great and unnecessary expense. That an inconvenience would, in his opinion, result from keeping a specification sealed, because it is one object of the specification that a man shall know when he is infringing the patent; and if the specification were not open to inspection, a man who had invented something of the same kind would not know whether he could work it with safety, because he could not see what the patentee claims under his specification; besides, if his specification could not be seen for fourteen years, it would very likely turn out that, at the end of the period, he had not given half his process, when he would have had his monopoly for so many years without giving the public the benefit of his discovery.

Mr. Wm. Newton, Machine Draftsman and Patent Agent, examined with respect to the French laws of patents.

States, the course of proceeding in France is to deposit a preliminary specification with the petition and other papers called the *Procès Verbal*, which immediately upon depositing you take a certificate for; you then pay one-half of the government charges, which vary according to the length of time for which you solicit your patent; you immediately take the certificate and get it enrolled, for which you pay a small sum, and that gives your patent precedence of all others that shall follow, even if another for the same subject come in the course of an hour. Your papers

are all sealed till they come before a consultive board of scientific persons, who if they find that the specification is not satisfactory, call for further information, and then a more perfect specification must be lodged. The duties of this consultive board are not confined to ascertaining whether the specification is full and complete; one object is to ascertain whether the invention is original. If it has been published in any printed book, they will refuse the grant, and on refusing the grant will *return the fees* paid. In France, a patent is open to have all improvements and amendments added during the whole period, upon paying a small fee. Perhaps a year or two after, when an inventor has made a sufficient number of experiments, he applies for a patent of *Perfectionment*, as they call it, and then he enrols his amended specification; and whatever the consultive board approves of, as falling within the range of the first claim, and entirely belonging to it, is granted as part of the original patent, on paying a trifling fee. In the opinion of witness, a similar course of proceeding would be highly desirable in England; because there are many instances in which the patentee, not being able to pursue his experiments and construct his machinery before the enrolment of his specification, has ultimately found that he was deficient in parts, and has been obliged to go through the whole process of obtaining patents for the three kingdoms anew.

Witness considers that a consultive board like that in France would be beneficial in this country, if composed of gentlemen who are not actually manufacturers or operative engineers; but who have been, and who are well acquainted with scientific matters. In France if there are twenty things claimed in a patent, and nineteen of them should turn out to be old, the twentieth still stands its ground without overturning the patent. A similar rule would, in witness's opinion, be exceedingly desirable here.

Supposing a patent in France is attacked in a court of justice, is it an answer to that attack that the Commissioners have investigated it and have granted the patent, and that therefore any objection to it is precluded?—No; I believe the Commissioners do not take any such responsibility upon themselves, and I do not think it would be expedient that they should do so; I think that that which the Commissioners do is tantamount to that which the Attorney-General here ought to do; he reports that he *has examined this subject*, and thinks it will be for the benefit of the country that the King should grant a patent; whereas we all know that the Attorney-General is otherwise occupied.

Then you conceive it is no defence to the patentee himself to say, that this has been examined by the Commission?—I think none at all.

Are patents ever overturned in France, upon the ground of their not being sufficiently described?—I think that never can be a ground, because it would be known in the progress of the investigation that such would be likely to be a ground of opposition to it, and the parties would take care to amend it. In France, the specification is always open to have a rider appended to it, while in England you cannot alter a single letter which you may even have inserted in error. I have lately been obliged to go over a patent again, in which there was an error of a single letter only; it was the word *pressing* instead of *dressing*; and I have been obliged to solicit the patent again.

Do you happen to know whether it is a bar to taking out a patent in France, if they know that that patent is already in existence in another country?—No, that is not a barrier to taking out a patent in France; there is a condition that, when you take out a patent in France, you shall not take out a patent any where else, or, if you do, your patent in France is vitiated: the same happens in all the other Continental States, but that is got over with the greatest ease, because you employ your agent, or your brother, or your friend; and so an invention runs through all the countries, beginning in America and coming to England, then Scotland, then Ireland, then France, Holland, Prussia, Austria, and Russia; and that is the course they generally take all the way, under different names, beyond England, Scotland, and Ireland.

Do you know what is the expense of a patent in France?—It depends upon the length of time for which it is granted; the patents are granted for five, for ten, and for fifteen years; the Government-duty upon a five years' patent is 300 francs, about 12*l.* exclusive of other fees, enrolments, and so on, which are trifling; for ten

years, it is 800 francs, which is 32*l.*; and for fifteen years, it is 1500 francs, which is about 60*l.*

Being further examined, with respect to the English law and practice of patents, states, that he has known much inconvenience to arise from the length of time that elapses between a person's application for a patent and obtaining the Great Seal to it; frequently his invention gets superseded. Considers one cause of this to be the irregularity at the Secretary of State's Office; has known those papers which have been sent first delivered last, and many boxes of papers sent to the King retained for weeks together, nay, for some months, under peculiar circumstances, his Majesty being either indisposed or greatly occupied with other business. Thinks that to secure a patentee from piracy, during the time between his first application and the sealing of the patent, would be very desirable; and that for this purpose there should be appended a sort of specification to his petition in the first instance, and that from the date of presenting that petition he should have the priority of right. Conceives that a caveat furnishes scarcely any protection at all, but has frequently known petitions for patents successfully resisted, in consequence of notice given on caveats. Thinks it would be extremely desirable, if the present cost of obtaining patents could be reduced; they are more expensive in this country than any where else: in France, the government-duty upon a five years' patent is 300 francs, about 12*l.*, exclusive of other fees, enrolments, and so on, which are trifling; for 10 years, it is 800 francs, or 32*l.*; for 15 years, 1500 francs, or about 60*l.* The expense, too, in this country, operates unequally; it being nearly the same for an invention which is of an ephemeral nature, as for one which may be in full and profitable use for fourteen years. Is convinced that in consequence of the great expense of a patent, there are many things lying dormant that will ultimately be lost, and that many have been lost. Admits that if the expense were reduced, persons might be tempted, by some short-lived advantage, to take out patents, which they would afterwards not think of sustaining; but does not see how this would affect the public injuriously. Is aware that a great many patents are taken out where the invention has not been carried into effect. Knows some very valuable inventions which, if they were in the hands of the public, would be very useful, and spread far and wide; but which, for some cause or other, remain dormant. At present, there are no means of setting such patents aside; and this witness regards as an evil which should be remedied. In France, persons having patents must work them within two years, or else forfeit the right. Approves of the plan of a commission composed partly of scientific men and partly of lawyers, to decide on all matters relating to patents, as greatly preferable to the existing tribunals; and thinks that if such a commission were appointed, the expenses now incurred in maintaining patents in the ordinary courts might be lessened, at all events its decisions would be more satisfactory. Has no doubt that lowering the fees considerably would much increase the number of patents, and sees no difficulty that could arise from patents being taken out for all sorts of small improvements; because if these improvements were so trifling as not to be worth notice, they would sink into insignificance, and, if good for any thing, the parties introducing them ought to have the benefit. Does not think that the existence of a great many small patents would operate as an impediment to the progress of other considerable improvements; and is generally of opinion, that for every discovery, however small, made by a practical workman, a patent should be granted.

25th May, 1829.

Mr. William Newton, again examined.

States, that he considers it extremely desirable that there should be a consultive board, as in France; that they should examine the specification, and have it rectified where necessary, according to the best of their judgment, but that they should not be responsible for its ultimate correctness; that it should have the power of saying for what period the patent should be granted; and of granting it for even a longer period than 14 years in important cases; and that it should also be empowered to extend the limits of the original grant. Does not think it to be a matter well defined, what sort of publication should prevent a person obtaining a patent. The words of the patent are, "make use, exercise, and vend;" and upon that ground, it is considered that

if any body has made, used, vended, or exercised that thing before, that will defeat the patent: now the publication of an invention in a book, is not either making, using,* exercising, or vending it; and yet it is notorious, that the statement of an invention in a book will prevent a patent being taken out for it. Patents are most frequently set aside on account of some trifling fault in the specification, the result of ignorance, or want of caution; thinks this a grievance, and that every patent should be sustained to the extent of what there is new in it. Thinks that a patentee should be at liberty to add at any future time, such improvements as may occur to him; and that no patent should be refused, because some notice or hint of the invention had been publicly given before, only on the ground of its being actually in use. Deems it advisable, that the three kingdoms should be included in one patent, but would have copies of the specification deposited in the three capitals for inspection.

Mr. Charles Few, being again examined,

Read to the committee a paper containing his ideas of the sort of commission which should be appointed for deciding on patents; and a form of process adapted to it. Would invest in this commission the whole of the powers now possessed by the Attorney-General, and no more, except that they should have the additional power of permitting an inventor to add to his specification any amendments that may occur to him during the period of his patent.

Mr. Moses Poole, Clerk in the Patent Office, examined.

Does not see any defect in the present law, except, perhaps, that the specification might be made more sure. Neither any inconvenience if the law is properly followed up; being farther interrogated, however, admits, that there is an uncertainty, what is and what is not the law! that there are, in truth, a great many inconveniences attending it, and thinks well of the plan of transferring the powers of the Attorney-General to a Commission.

Do you think there is any inconvenience as to cost, in taking out the patent at present?—I do not think it is too dear.

What is the whole expense?—About 360*l.* for the three kingdoms; if there is a short specification, and no opposition.

What advantage do you conceive is derived to the public, from making the price of a patent so high?—It prevents patents being taken out for too trifling objects.

What inconvenience do you think would result if patents were to become more numerous, and they were to be taken out for trifling inventions?—It would be, I think, to the injury of the common tradesman. A patent is an exclusive right to the vending of a certain article, and of course the patentee has a privilege over the rest in the same trade; if he gets that privilege too cheap, it would be to the injury of other tradesmen in the same line.

If he makes a useful discovery, why should he not derive the benefit of it?—The privilege is so great when the thing is worth any thing at all, he ought to pay for it.*

You have no objection then to the present expense?—No; I have known them to get 130,000*l.* by a patent; they all run the risk of losing by it, and those who get so much pay no more than those who lose by it.

Mr. Poole, at the conclusion of his examination, delivered in a statement of the expense at each of the offices in taking out a patent; of which statement the following is a summary:—

Expense of a patent for England, exclusive of the cost of the specification, which varies according to its length	106	11	8	Of which sum there is expended for Stamps....	41	2	0
Ditto, for Scotland	79	10	5	Ditto	6	10	0
Ditto, for Ireland	128	5	11	Ditto	26	3	4

Mr. Joseph Merry, Ribbon-Manufacturer at Coventry, examined.

Is in possession of three patents; went to trial upon one, and was nonsuited; the specification was not a good one, and does not believe there is one in a thousand good; conceives it to be almost impossible to prepare a

* Query.—Is it not *using* of it for the purpose of publication?—Edit. M. M.

* That is for conferring a benefit on the public?—Edit. M. M.

specification that will stand in a court of law; not in consequence of the specification being drawn up before the machine is actually complete, but because of the difficulty of describing it after it is complete in such a way as to satisfy a jury; the specification being required to be so very minute, and a trifling inaccuracy in any point—even a point not of the least importance to the working of the invention—being held to invalidate a patent.* Witness has now a patent for making ribbon velvets, which he has had locked up for five years; the improvement is so great, that he can make forty pieces of this article while another person is making one. Has not practised the invention, because if he were to begin working it, all his neighbours would immediately do the same in defiance of his patent; the specification is not worth a farthing;† and does not believe it possible to make a specification upon this loom that will pass in a court of law. Does not mean to say that if the specification was sufficient, the law would be then inadequate to his protection; but does not mean to go to law again about a patent, and would sooner relinquish it altogether. Would have no specifications at all; thinks it would be better to send the identical machine by which the thing has been effected before a proper board, who should have power to decide what was an infringement and what not. Is of opinion that a scientific commission for the decision of disputes upon patents would be very desirable, and likely to be generally satisfactory to the manufacturing community, provided it were impartially appointed. Thinks that were the lodging of a model substituted for the specification, that model should be kept for the inspection of the board alone.

Mr. Samuel Morton, Manufacturer of Agricultural Implements, examined.

Is concerned with his brother, Mr. Thomas Morton, shipbuilder, in a patent apparatus for hauling ships out of the water. Does not think the price of patents a thing to complain of, provided they afforded sufficient protection to an inventor, which he does not consider they at present do. Found in the case of the patent slip above alluded to, that the publication of the specification was injurious, and is rather in favour of having the specification concealed. Is of opinion that the proposed commission would be considered by the manufacturing community a much better tribunal to decide disputes as to patents than the ordinary judges and juries; and would give such a commission the power of extending the terms of patents in particular cases.

Mr. Samuel Clegg, Engineer, examined.

Has known great inconveniences to arise from the general terms in which patents are now worded, and from not stating at the time a patent is applied for with sufficient explicitness what the patent is for. Thinks that if the title were made more particular, greater time might be allowed to lodge the final specification, which would be a great advantage. Considers that in many cases the period of 14 years is too short to enable a patentee to turn his invention to a profitable account. Instances the case of his own gas-meter, which he invented about 14 years ago, and ten years of the patent for which are nearly expired; on this he expended some thousands of pounds, and scarcely got one into the market: now it is getting generally used, and if the time could have been extended, witness would have been remunerated and made a profit; as it is, it has been a loss to him. Applied to Parliament to get it extended, but did not succeed. Thinks it would be a convenience if persons were allowed to take out patents for short periods at a proportionably smaller expense. But does not consider the present expense of taking out a patent as any evil; it would be better if it were more (!!)

On what grounds do you think the present charge for patents not too high? If it is any thing worth taking out a patent for, I think the expense is no consideration, because half a year's profit would pay the expense of a patent.

If the price of patents were very much reduced, do you think that patents would be taken out for very minute details?—I think in that case the Patent Office would be so loaded, that a person could hardly bend an iron in a particular shape without running the risk of infringing a patent.

* Mr. Merry is certainly wrong in his law; nothing is better decided than that the inaccuracy must be *material*.—ED. M. M.

† Mr. Merry must, of course, have intentionally given in a deceptive specification; otherwise his neighbours need not wait for his reducing the improvement to practice, to avail themselves of it.—ED. M. M.

Do not you think that the multiplication of patents to a great extent would be a great impediment to improvements in machinery and the arts?—Yes.

Have you known any instances of patents for small things which have stood in the way of improvements?—I cannot call any to mind at present.

Are not workmen and people of that description constantly in the habit of making little observations and small improvements?—Yes, sometimes very important ones arise from the workmen. If a workman has discovered any thing of the kind, and finds it likely to be beneficial, there is no difficulty in procuring any one to join him in the expense of taking out a patent for it (???)

Do you not think that if it became a habit among that class of people to secure patent rights for those small discoveries at low rates, it would be very inconvenient?—I think very much so.

You mean to say that between 300*l.* and 400*l.* is not too great an expense for a patent for the three kingdoms?—No: I should think it would be no worse if it were a little more; it bears no proportion to the expense of completing a machine, or of defending it when infringed.

Have you ever considered whether it would be inconvenient to inventors to have their specifications sealed and concealed from the public?—I think it would be an inconvenience. I think it would not be a proper thing towards those engaged in the same line: there may be things sealed which other persons may be pursuing with vigour and expense. I think after it is once secured, the more public it is made the better.

Professor Millington, examined.

Agrees with the preceding witness as to the evils arising from the generality of the titles of patents, and the advantage that would be derived if inventors were obliged to be more particular. But even now the passing of a patent may be opposed successfully on the ground of the vagueness of the title. Has known many instances of a title refused by the Attorney-General because it was too general. There are so many vague titles, because there is no objection made to them under caveat, or in any other way. A short time ago, a Mr. Wollams applied for a patent for the improvements in carriages; that was sent back again because it did not state in what part of the carriage the improvement was to be. Admits that as the law now stands, if an inventor were to state his invention very precisely in the title, he would be exposed to the chance of having the invention discovered before the sealing of the patent; but would assimilate our law to that of France, where the specification is lodged in the first instance, the invention is secured to the patentee from the date of his application; and he is allowed, for a trifling fee, to amend his original specification as often as he may see proper.

Does the specification undergo much examination before the commissioners in France?—It does not appear to me to undergo any, because I have known them enrolled with imperfections, and they pass them without difficulty.

After a specification has passed that commission in France, are the public at liberty to question it in a court of law upon any doubtful point?—They are precisely as in England; there is this difference only, that in France the infringement of a patent is penal, which is not the case here. In England it is a mere question of damages; but in France it is penal to evade a patent, and the spurious articles are burnt by the hangman.

Are you aware whether or not specifications in France are concealed from the public?—I am not. In England, I believe, they can only be concealed by authority of Parliament, and there have been instances with us of concealed specifications.

[From our anxiety to include every thing which has the least practical bearing on the questions raised by this Inquiry, our abridgment of this evidence has extended to a greater length than we anticipated. The completion of it we must reserve for our next Number.—Ed. M. M.]

INTERIM NOTICES.

Communications received from Δ—Mr. Richard—Mr. Massingbird—Mr. Harrison—R. S.—Mr. Davy—Y. P.—Mr. Collins—A Reader at Lincoln—Inquisitor.

Erratum.—In a few copies of the first sheet of this Number, the two notes at the bottom of p. 365 have been transferred by mistake to p. 368.

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PILE-DRIVING MACHINERY.

Fig. 4.

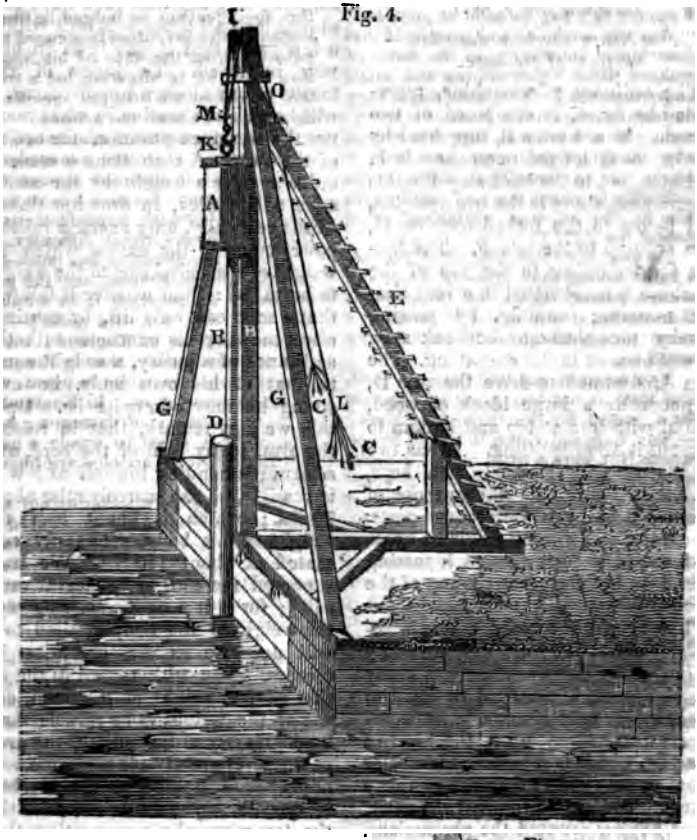


Fig. 5.

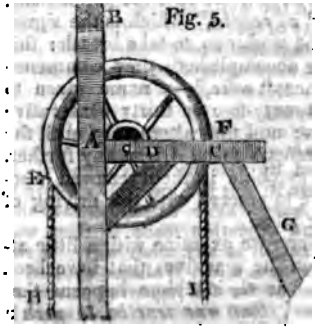
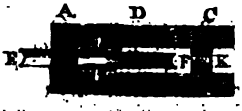


Fig. 6.



DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. 6.

PILE-DRIVING.

(Continued from p. 307.)

The ordinary machine described—defects of the same.

The ordinary pile-machine, represented by fig. 4, is composed of two upright grooved posts B, supported by side braces GG, fixed upon the sole F, and attached to the back stay E; this is connected above to the two uprights, and below to the forked framing H, also secured to the sole F. The ladder for mounting to the top of the machine is constructed in a very simple manner; namely, by passing wooden pins through the back stay, as will be seen in the engraving. The ram A, destined to drive the pile D, is generally a large block of wood, bound with iron at top and bottom to prevent it from splitting. It has two tenons or ears stopped with keys, driven in behind for the purpose of keeping it between the grooved posts. There is also a ring to receive a hook, K, fastened to two cords, each passing over a pulley placed at the top of the two uprights.

The weight of a wooden ram is generally about 800 lbs.; so that twenty men pulling downwards, by as many ends of cords C attached to the two main ropes, may afterwards let it fall by its own gravity upon the head of the pile, which is repeated, blow after blow, as many as twenty-five or thirty times. Those who conduct the gang, after having counted the percussions, cry "*au renard*," which is the signal for the workmen to take breath: this being accomplished, they commence another "*volée*,"—a name given to the twenty-five or thirty consecutive blows; and thus alternately, until the pile refuses to be driven any further. The machine is then removed elsewhere to proceed with the driving of other piles.

When we examine with a little attention the machines that have been chiefly used, it seldom happens that we find them constructed in such a manner as to fulfil perfectly their object, being almost always deficient in their essential parts, and producing considerably less effect than they might be made to accomplish.

Ancient as the machine of which we are now speaking is, and notwithstanding so many able men have employed it at all times, it is only within a few years that it has been in any way improved. To judge of the merits of our modern improvement, it will be well to examine in what manner the workmen produced the action of the ram. A man using a cord, in order to raise a weight by the assistance of a pulley, in drawing downwards vertically, only exerts a raising power equal to the excess which the weight of his body bears to the weight to be raised: from whence it follows, that a man can only lift, by continually renewing his exertions with the assistance of a pulley, a weight equal to that of his own body, however strong he may otherwise be. Upon this we may remark, that in rising the arms to lay hold of the cord, and afterwards bending himself as low as is possible, he can scarcely raise above 70 lbs.; which is about half the weight of his body, commonly estimated at about 140 lbs. We have supposed the cord to be drawn vertically; for if it were drawn sideways, the weight of the body applied to it will decrease as the obliquity increases, taken with regard to the action of the weight of the men, and not of the weight to be raised; since by a property of the pulley, the sums of the lever are always the same. To apply this reasoning to the machine in question—you are to consider that the ten men who are exerting their powers at the ends of cords answering to the main ropes I L, can only draw obliquely with respect to the vertical line I N, and the same also with respect to the main ropes I L; since in both cases they make a circle, in which those who are opposite to the others destroy reciprocally a part of their action, which is here an inevitable defect: since it is necessary that the ten men should be placed in a ring to act together. It is not the same with the obliquity I L; this may be applied in a more vertical direction, by passing

the cord M, I, L, over a wheel 4 or 5 feet in diameter, instead of which the diameter of the pulley seldom exceeds 10 or 11 inches; therefore there is no doubt that instead of the 40 lbs. each of the twenty men is supposed to borrow from the weight of his body to raise a ram of 800 lbs., he can only exert nine or ten at the most upon the whole quantity. This fact is confirmed by experience; for by employing a wheel instead of pulleys, sixteen men can raise the same ram of 800 lbs., each being able to exert a power of 50 lbs.

It remains now to be shown in what manner the machine is to be constructed, to supersede the use of pulleys by means of the wheel. By referring to figs. 5 and 6, will be seen the plan and side-view of the apparatus. To render the pile-machine susceptible of the preceding advantage, it is only necessary to modify the top part to effect it; I have therefore only shown that portion for the purpose of explanation. A marks the two grooved uprights, crowned with a cap B; each of the posts is connected with a piece placed horizontally three feet under the cap B: these pieces are fastened together by a cross-quarter of timber, supported by the back stay G, which is fixed in such manner as not to obstruct the placing of the wheel E F, which has its nave pierced with a square iron, from which the trunnion or axle projects, and rests upon its bearings D. More steady action and solidity is gained by this method, than if they were not united with the square iron inserted in the nave of the wheel. This wheel I have supposed to be about 4 feet 6 inches diameter, measuring from its channel, and distant from the posts A about three feet. This arrangement enables the workmen to operate with greater facility, having more room for placing themselves in a ring, and enabling them to pull in a more vertical direction at the other end E H, which answers to the ram—the more so, as the back stay and ladder G not being in the way, the sixteen men are employed in pulling only one rope, and not divided into two separate bands—the action in the latter case never being perfectly alike. Another advantage to be derived from the wheel is, that there is only one movement required to counterpoise it—about one-third of the circumference of the wheel for each blow—it becoming greater by the acceleration that the ram acquires. The pulley on the contrary, in consequence of the smallness of its diameter, makes nearly two revolutions when the ram rises or falls, thereby causing more resistance on account of the stiffness of the cords.* We may also add, that the same cords or ropes are not so soon worn out with the wheel as with the pulley; since it is known that in working one will last as long with the wheel, as three will with the pulley.

M. Pollast, inspector-general of the bridges and roads of France, having improved in this manner the machines that he used in the construction of the bridge of "Poissy sur Seine" in 1747: he found them to answer so well, that he reduced the former brigades or gangs of workmen consisting of twenty men to sixteen, performing the same work.

The foregoing observations, which I have chiefly extracted from M. Belidor, may be applied with equal force to the various modifications of pile-driving machinery hereafter-mentioned, and in the choice of them considerably guide the judgment. The same writer proceeds to give an estimate† of the time and expense necessary for the driving a number of piles into earth containing four different stratas: his remarks in this respect are not only verbose, but totally insufficient for the present practice; for these reasons I shall decline inserting them, and as a conclusion to this paper add a few

General Remarks.

With the present machine a pile may be driven with great expedition, as it is effected by a series of smart shocks given in succession. The workmen should, however, take advantage of the rebounding of the ram

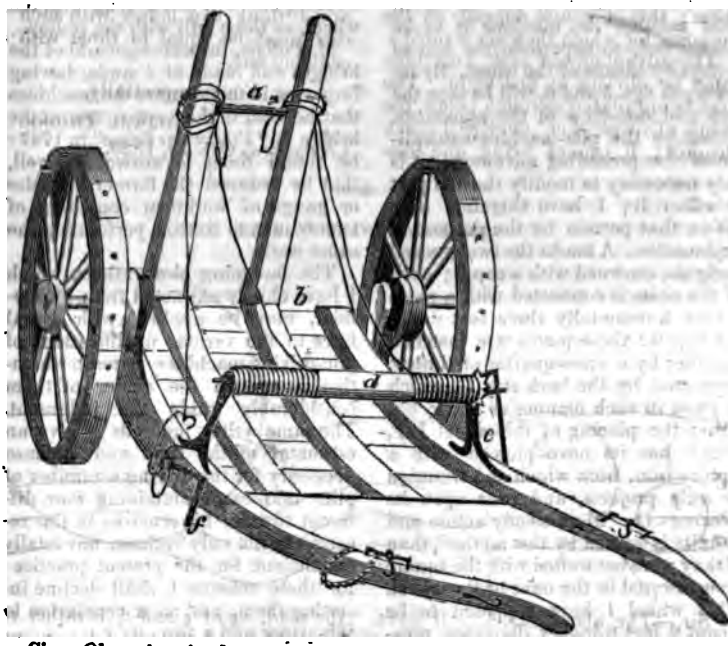
* Belidor, Art. 308.

† M. Belidor supposes, in the first place, that the pile is to be driven in sixteen feet, and through four different strata, each pile, according to his estimate, occupying in time 3h. 5m. 34s., and the average expense of each, 6 liv. 10 sols, 8d. Lastly, that six piles can be driven with the aforesaid machine in twenty-four hours.

by pulling immediately that effect takes place; much labour may be saved by attention to this point. The advantages of the machine in isolated situations is obvious. A workman, unaccustomed to the arrangements of machinery, may in a few hours construct a powerful machine like the one represented, and by inclining the grooved upright posts (technically termed *shears*) the machine may be altered for the purpose of driving piles in inclined positions for abutments, &c. It must at the same time be distinctly understood, that it will not bear to be brought into competition with the machines now in general use, where two men, with the aid of a wheel and pinion, will effectually perform the driving of large piles that would require sixteen men using the one described, and for which M. Belidor has made his calculations.

(To be continued.)

GUERNSEY CART.



Sir,—Observing in the newspapers the description of "a new conveyance for heavy goods,"* I am induced to send you a rough sketch of the carts in common use in Guernsey and Jersey, whence I returned a few days ago, and of which the machine described in the papers appears to be only a bad copy.

The platform in this cart is considerably longer than that of a common cart, I think it cannot be less than seven feet; for I frequently saw two casks of tallow on one which did not occupy the whole of it.

The wheels are not higher than those of common carts; these, of the "conveyance" alluded to are described as seven feet high; they must, therefore, be much heavier and more cumbersome than is necessary. The body or platform is not more than a foot from the ground. But what struck me most in the construction of the Guernsey carts, was the ingenious contrivance for loading and unloading particularly heavy casks, such as hogsheads of sugar, tallow, &c.

* Alluding, we presume, to that recently introduced in London by Mr. Wilberforce, Jun.

There is an inclined plane *a*, which in loading and unloading is let down so that its end lays on the ground, connected by strong hinges *b* to the platform; in front of the platform and strongly attached to the shafts is a small windlass *d*, with a ratchet-wheel and click at one end *c*, which is turned by a winch or winches *f*, hung in two staples, and always carried with the cart. Two ropes pass from this windlass round the cask to be loaded, and are fastened to any part of the shafts on each side, as at *c*: many of the carts have sides to them; this of course depends on the purposes for which they are wanted.

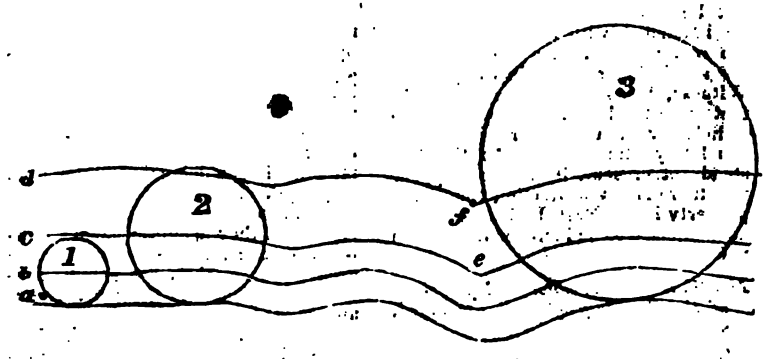
The advantages of such a machine must be obvious at first sight. The load being placed so much below the points of suspension, renders it much steadier; it cannot wring and distress the horse so much, and there being little or no weight upon his back, he is not likely to fall; and if such an accident should happen, the load would not be disturbed, or prevent his getting up again. The line of draught being so low, he draws at right angles with the slope of his shoulder, and is consequently enabled to exert the whole of his strength upon the resisting body, and the fore-horses partake of the advantage. I am much surprised this machine has not been adopted in London, for it appears admirably adapted for rough pavements; and I think two horses with such a cart must be equal to three with a common one.

Yours respectfully,

MILIWAL THIONK.

Chelmsford, Oct. 15, 1829.

LARGE AND SMALL WHEELS.



Sir,—The above sketch will serve to illustrate the assertion of your respectable correspondent, Mr. Baddeley, Jun., vol. xii. p. 174. Supposing the line *a* to represent the uneven surface of a road, and 1, 2, and 3, three wheels running on it, the lines *b*, *c*, and *d*, will show exactly the course which the centres of the said wheels will run, and prove the truth of Mr. B.'s assertion, and consequently that it will be easier for goods or persons to travel in carriages with high wheels than with low ones. The shape of the courses, *e* and *d*, where the wheels are going over a hole in the road, as at *e* and *f*, is rather remarkable, and must be felt very sensibly by the traveller. I cannot help noticing that the difference between the line formed by the axle, or centre, of the large wheel, 3, and that of the small wheel, 1, is not so great as Mr. B.'s letter would lead one to expect. It is possible, however, that the circles in the annexed sketch may not be sufficiently large to show the difference correctly.—I am, Sir, your old subscriber and correspondent,

BENEVOLO.

Dec. 7, 1829.

MINUTES OF EVIDENCE ON THE PATENT-LAWS.

(Concluded from our last No. p. 384.)

Professor Millington being further examined, stated; that it has always appeared to him that the chief inconvenience of the existing system is the necessity of preserving secrecy during the period allowed for specifying: another great inconvenience is the obligation on the parties to attend personally to acknowledge their specifications. The appointment of a scientific commission for the decision of all questions relating to patents was a favourite notion of the witness some years ago; but there seems to be great doubt as to the possibility of obtaining commissioners, or of getting the duty performed in an efficient manner, without partiality or prejudice. Thinks that it would be well if one patent were made to serve for the three kingdoms; but does not consider the present expense an evil, provided the patent were made a secure property. Deems it rather an advantage that a patent should not be too cheap; the world would be inundated with them if that were the case: would have the same time for specifying granted in every case. Witness, in conclusion, begged to direct the attention of the Committee to a difficulty of a peculiar kind which has lately started up. As the law stands at present, it does not appear that there is any protection for patent property in the East Indies; they are not supposed to be included in the term "Colonies."

Mr. W. H. Wyatt, editor and proprietor of the Repertory of Arts, examined, states,

That the "Repertory" contains many hundred verbatim copies of specifications, and a list of every patent that has been obtained since 1795. Has a private volume containing a list of every patent obtained since the time of James II. In 1794, when the "Repertory" was first published, the number of patents in a year was about 50 odd, and it has subsequently increased to 300 for England alone. Of late they have decreased very much; there are now from five to a dozen in the course of a month only. Conceives that the system of granting patents has not only tended much to stimulate inventions, but that it has been a greater spur to the improvement of the arts and manufactures in this country than any other system that could be adopted. No (fixed) sum of money will gratify an inventor; if it is indefinite, his expectations are very great. Believes, that the present state of the law is a subject of universal complaint, and that it is attended with great inconveniences. Has known mischief to arise from the different periods for enrolling specifications. One person who has a patent for an improvement will have perhaps six months, and another who takes out a patent for a similar thing immediately after may have only two; the latter being compelled to specify first, has no protection against the other's incorporating his invention in his later specification. Such incorporation would vitiate the patent of the person guilty of it, if it could be proved that he had incorporated what he did not invent; but that is a negative which you cannot easily prove. Thinks the policy of permitting patents to be taken out for inventions communicated from abroad by foreigners is very good, because the great object is to improve by all available means the manufactures of the country; but is of opinion, that so far as the law prevents a patent from being taken out for an invention communicated by a British subject abroad it should be altered. There has been much complaint as to the expense of patents; but is of opinion that if you decrease it much (and unless you did it would be no benefit), it would so increase the number of patents that they would become a public nuisance; for notwithstanding the great expense, there are patents continually obtained for the most trivial, absurd, and old things.

Would it not be a better check to patents being granted for frivolous inventions if the parties who were to judge of the propriety of granting patents were more narrowly to sift them in the first instance?—It would certainly be a check, but I do not perceive any advantage in that check; a great deal of discontent would frequently arise; parties would complain of being prevented.

Have you any other suggestions to offer the Committee?—Conceives that all the defects, at least a great portion of them, might be remedied if an Act were passed dispensing with the King's sign-manual, and authorising the patent to be granted by commissioners. Has known patents delayed several months waiting for his Ma-

jesty's signature, during which period the invention has been discovered by others, and the patent rendered of no effect." Thinks if the specification took place of the caveat, and were entered for twelve months, or some definite period, with power to substitute at a certain period a more perfect one, it would be an improvement; that is, that the patent should take date from the lodgment of the specification, and that the party should be at liberty to consult all the world on preparing (perfecting?) it. Thinks it would be also an improvement if all the specifications were enrolled in one office; and not literally enrolled, but copied into a book. It would be likewise very advantageous if all the specifications were collected from the several offices, and properly arranged and indexed, so that they should be of easy access.

Mr. John Macarthy, examined.

Have you any suggestion to offer with regard to the laws relating to patents?—With reference to the price of patents, I think it is too high. To a man like myself, an officer on half-pay, and having a family, it is a very heavy expense; and I beg to say, with reference to the specification, that in all the patents I have taken out (of which I have had as many as four), I have always taken care to have six months; but in more instances than one I have known six months not sufficient time. I have been obliged to specify before the matter has been ripe; but at the same time, I believe there are many inventions that would allow a patentee to enrol his specification next day. I want at this moment to take out a patent with reference to a shoe for an elephant in India, but I must traverse by proxy to India before I can specify. I have heard that it has been proposed that there should be a Board to sit upon inventions. I believe it is the practice in Russia, but it is productive of a great deal of mischief to inventors: inventions are often brought before them with respect to which they are not competent judges whether they are good or not, and they are often, in consequence, thrown out. An invention may appear a very silly thing, but at the same time it may turn out very profitable; and there may be a very valuable invention that may perhaps come to no good.

Supposing there were a Board appointed, not composed of lawyers, but of scientific men, and that their attention were to be directed, not so much to the usefulness of the invention, as to the sufficiency of the description, should you have any objection to a Board of that sort?—No.

Benjamin Rotch, Esq., Barrister, examined.

Thinks that the uncertainty of patents, and the difficulty of maintaining them, are not particularly owing to defects in specifications; and does not approve of the plan of a Commission to examine specifications, if the approbation of such Commission is to absolve patentees from all farther responsibility. In three cases out of four, it is the main object of the patentees to deceive the public if they can; and nothing but the dread of losing their patents altogether keeps them constantly from imposing false descriptions on the public. A correct specification is the only return the public get for the monopoly of 14 years; and in proportion as you lessen the responsibility of patentees, the less chance you will have of obtaining such correctness. Commissioners, too, get almost uniformly careless in the course of time. Never knew of but one case in which a patent was upset for want of a proper description of the invention. Many patents are, it is true, upset on the specification; but it is on points, arising out of the uncertainty of the law as laid down in the old Statute of Monopolies, which the witness considers wants many material alterations to adapt it to the present time. The Statute allows patents only to be granted for new "manufactures." Now, by some Judges this term is held to include new processes by which old manufactures are carried; and by others, new manufactures only in the strictest sense. Again, Lord Mansfield has said, that when you want to know whether an article is patentable, you have only to ask yourself whether it is *vendible* or not: while Lord Tenterden, in a celebrated judgment in the case of Wheeler, has set us all at sea on the subject by a definition which shows that his Lordship was, in truth, very much puzzled. He says, "the word *manufacture* has been generally *understood to denote* either a thing made which is useful for its own sake, or vendible as such; as a medicine, a stove, a telescope, and many others; or to mean an engine or instrument, or some part of an engine

or instrument to be employed either in making some previously-known article, or in some other useful purpose, as a stocking-frame, or a steam-engine for raising water in mines; or it *may perhaps* extend also to a new process to be carried on by known implements or elements acting upon known substances, and ultimately producing some other known substance; but producing it in a cheaper or more expeditious manner, or of a better and more useful kind: but no merely philosophical or abstract principle can answer to the word *manufacture*." It was that little word *perhaps* which set us all at sea, and nobody can say positively what title to a patent the Courts will support or will not. Another distortion which the Judges have made of the Statute of Monopolies, because it is not wide enough to meet the necessities of every case, relates to the persons to whom patents are granted. The Statute says no patent shall be granted "except to the true and *first* inventor;" and yet the Judges sanction patents to the importer of foreign inventions, holding that he is to be considered as the "true and first inventor." The remedy which witness would suggest to put all this straight, would be to adopt the common-sense decisions of the Judges, and to form a Statute which shall embrace those objects which, although without the pale of the Act, are every day the object of patents, and sanctioned and supported as such by the Judges. There is another point on which all the Judges are at variance, namely, whether or not a new principle reduced to practice may be the subject of a patent. The present Chancellor, Lord Lyndhurst, holds that it should; and witness would have this decision made law. Illustrates the expediency of this by the following case:—A person in Scotland has lately discovered that in distilling spirits if the wash is thrown into the boilers in the form of a shower, by which a greater surface of the wash is exposed to the heat than if it were laid in one mass, he can distil four times as quickly. Now, there are fifty ways of effecting this: you may, for instance, force a jet against a triangular piece of metal with such force as to distribute the whole into a complete mist in the still; or you may drain it through horse-hair cloths, which will let it come through in drops. The grand invention was *the first thought* of exposing wash in that minutely subdivided state to the action of the heat; and in witness's opinion the patent in that case should be granted for the principle, and the patentee should be under no obligation to state all the modes in which it may be carried into effect.

You began by stating that this shower would be a principle—a new principle; but if so, and if the same thing has been done before in a steam-engine to raise steam, would you call that a principle as regards distilling—both is raising a vapour?—That is getting a legal opinion from me as a lawyer on a subject which does not touch this question (Inquiry).

Can you define a principle?—Any new principle reduced to practice (1)

* * * * *

How do you define a principle?—Johnson's Dictionary definition of it: whether a thing is new or not must be the subject, and I hope ever will be the subject for a jury to determine. *Do the Committee wish me to state what I conceive may be a new principle?*

What the Committee would ask is this, as to that which you have defined to be a new principle—(the shower)—whether you would consider a man taking out a patent for that principle would give him the exclusive use of it, both as for distilling and as for the steam-engine; taking it in that sense—whether you consider it a new principle in each, or only a general one that would ride over each?—That again, as I said before, is a legal question; it must depend entirely on the way a man takes out a patent: supposing the principle to be new, and that a man takes out his patent for the principle of exposing water in the form of a shower to the application of heat as a good mode of raising vapour; if he takes it out for that, then I say he shuts the public out from using that principle for any thing.

Is the law different at the present day?—I am not aware I am introducing any new law; I am only settling what is law. Look at the steam-engine, that was a patent distinctly for a principle.

What principle?—Now describe *in words* what it is? Unless I have the patent before me, I cannot describe it.

What is the principle?—I do not sufficiently recollect the patent, but I can describe the lever-fid principle, if that will explain my meaning.

You said the patent was "distinctly" taken out "for *a principle*?"—Yes.

Interpret to the Committee what you meant by the word *principle?*—I will take another patent that I am more familiar with for my illustration. A person takes out a patent for a lever and that supports the topmast of a vessel; a man takes out a patent for doing that by means of a lever; I should say the principle is the doing it by means of a lever, however arranged or contrived.

Should that embrace a screw—a screw is a lever?—Certainly not; it has been held over and over again that we are to take terms as they are understood mechanically and technically, and not philosophically. I never knew any difficulty to arise until to-day as to defining what a principle is(!!!)*

Mr. Rotch next directed the attention of the Committee to the effect of want of novelty in upsetting patents: the Statute of Monopolies confines the novelty to such manufactures as others *at the time of taking out the patent* shall not use; but the Judges have completely perverted the provision in the present day—they admit evidence of an invention having been used *at any time* preceding the taking out of a patent. Apprehends that it would be a great improvement if the letter of the law were adhered to; if it were always understood, that when a thing has gone out of use, if any person—provided he be also the inventor, though not the first inventor—shall introduce it in such a form again as shall make it an object to be very much desired, he shall be entitled to a patent. If it is not in use, there is no vested interest to be injured by granting it. But would it have distinctly ascertained that the person applying for a patent for a thing which once existed before had actually invented it a second time; the proof of which should be his own affidavit to that effect?—Thinks that the right of every patentee should date from the time of his first applying; and that in return for this, he should describe the nature of his invention more fully in his title or petition than he does at present. Agrees with preceding witnesses as to the tricks and frauds occasioned by the present practice of allowing patentees different periods to specify. Has known one man upset another because he had the ear of a person about his Majesty, who could get his paper signed; and has also known 100 guineas given for signing one paper before another. Would make the period for specifying the same to all, and that period two months. Is excessively averse to the plan of a Commission to examine specifications, and thinks the public would be ill served by it indeed.

3d June, 1829.

Arthur Howe Holdsworth, Esq., a Member of the Committee, examined.

Conceives that the notion expressed by some of the preceding witnesses, that patents may be multiplied to too great an extent has arisen from this—that as the law is not clear with regard to patents, so many are obtained that appear defective in law, and by confusing workmen really do mischief: but if the law be made so clear and defined that a patent for a something really useful, when taken out, would be found to be secure, then witness cannot conceive that we can have too many patents, as they are the reward of men's ingenuity. One man has a property in the funds, another in land, a third in the powers of his head, evidenced by his inventions; and if you were to attempt to limit the number, you would at once cramp men's ingenuity, and not give those who are clever their fair value in the market, because their brains are the only property they possess. Does not consider that it is for the purpose of improper deception that persons so often give titles to patents which do not at first sight indicate the thing they ultimately specify; but that patentees are driven to this course in order to guard themselves against the danger to which they are liable, under the present state of the law, of being

* We have given this portion of Mr. Rotch's evidence in his own words, because its authenticity might have been reasonably doubted on any other authority. As its worth however—like that of other flimsy things—it best ascertained by compression, we subjoin what we submit to be a very fair abridgment:—

What do you mean, Mr. Rotch, by the word *principle?*—I mean that a principle is a principle.

But how do you define a principle?—As Dr. Johnson defines it.

And how does Dr. Johnson define it?—I forget how.

But can't you show by some example what you mean?—Yes, the steam-engine was a patent distinctly for a principle.

Well, what was that distinct principle?—I don't know; I can't tell!!!

We have not met with any thing more amusing in the way of cross-examination on a scientific matter since the noted Mr. Accum's celebrated examination before the House of Commons with respect to the areas of circles.—Ed. M. M.

defrauded of their invention between the time of taking out a patent and lodging the specification. Conceives that the best remedy for this state of things would be that recommended by other witnesses, namely, that the inventor should be secured from the time of his first affidavit, &c. But there remains a still more important difficulty to be got over—the difficulty of maintaining a patent, however good, after it has been obtained. There is, unfortunately, a very prevailing notion that a patent is fair plunder—that there is nothing dishonest in doing every thing to defeat a patentee: combinations are constantly formed to oppose and annoy him; and evidence suborned to show that the thing was known before the date of the patent, "such evidence as it is in the power of almost any man occasionally to obtain." Conceives that in this state of law and society patents, however good, may be rendered almost useless. The best remedy for these evils appears to witness to be this, that after a person has publicly used his patent for any given number of years—say five—and no one has thought it worth his while to bring a *scire facias* against him on the score of its not being a novelty, and therefore not a fit subject for a patent, whilst he has on his own part used all due diligence to prosecute infringements—the patent should be deemed good and valid; and that an injunction should issue against all future transgressors, and not be dissolved, the same as if his patent had been proved valid in Court. Believes that according to the existing law a principle cannot be patented unless reduced to practice; and thinks the law a good one. Conceives it would be better to drop the use of the word altogether, and that the Judges should be bound simply to consider whether the thing done be an entire and new fact, and one worthy of a patent. Believes that it would be advantageous in many instances to patentees, and not injurious to the public, if specifications could be kept concealed from the public; and sees no objections to such concealment, as long at least as the patentee does not find it necessary to come into Court to prosecute for infringements, when of necessity the specification must be made public.

Benjamin Rotch, Esq., again examined.

Proposes that instead of a patent being annulled because one or two things which are claimed in it as new are not new, a certain portion of the term only should be forfeited.

Mr. John Isaac Hawkins, examined.

Published thirty years ago in America "A View of the Real Nature of the Law of Patents," and objected to the patentee being charged any thing for having the expense of his exclusive privilege secured to him. The expense of a patent in America was then and is still 30 dollars (£6. 15s.). Found many cases where poor men had found out an invention, and spent the whole of their money in bringing it to perfection, to whom the expense of the patent was felt as a grievance. Pleaded the cause of the poor in the public papers at the time, and has not since his arrival in England seen any reason to alter his opinions. Has frequently undertaken to bring monied men and inventors together, but the negotiation has generally failed, because the inventor is afraid to disclose his invention for fear of losing it; and the monied man is afraid to embark his money in an invention with respect to which he is not completely informed. It is become almost a proverb, that few patentees ever reap the advantage of their ingenuity; and in the opinion of witness the expense of the patents is one cause of this state of things. Conceives the consequence of charging any considerable sum for patents to be, that none but bold speculators take patents. Thinks that if patents were given free of cost, the public would be benefited by the inventions of the cautious and sober-minded, and that thus a source of permanent wealth to the country would be opened. Is well acquainted with many cases in which a poor inventor has remained poor, while the capitalist has realized a great fortune by the invention, because the invention could not before being patented be shown to persons competent to judge of its value: has prevented a great number of patents being taken out in England and France, by laying before the parties the difficulties they would meet with in negotiating with men of capital, prior to taking out a patent; and firmly believes, that he is at the present moment the confidential depository of important inventions, which if they could be patented free of cost, and thus become marketable commodities, they would immediately occasion employment to thousands of people. Knows also of several instances of valuable inventions having been

lost to the public by the death of the inventors, when if the parties could have been made secure, they would have treated with capitalists, and the inventions have probably become important staple articles of manufacture. Would propose that patents should be put upon the same footing as copy-rights, or rather as statuary, for the protection of which there is a special statute. Would have the publication of any new discovery to constitute the evidence of exclusive right, and that the publication should consist in sending to certain offices written or printed copies of the specification attested by the signature of the inventor; and also advertising for sale copies of the same for a reasonable price in a certain number of newspapers. Placing patents on this footing, would tend to prevent monopoly by opening a wide door to competition. It has been apprehended by some that the great increase in the number of patents, which would be the consequence of throwing off all the fees, would occasion so much litigation, as to become a great public inconvenience; but in the opinion of the witness, this evil, if it should be found to exist in the early stage of the change, would soon correct itself; because every trial of a patent cause would tend to enlighten the public mind, and enable persons to decide many critical points without an appeal to a court of law. It is very probable that more litigation would be generated by the increase of a thousand ships employed in commerce, than the increase of a thousand patents; but who would imagine that an addition of a thousand ships employed in the commerce of the country would be a public inconvenience? Considers that the law as now administered is ill-adapted to the decision of disputes on patents, because juries are generally totally ignorant upon the subject; but if a special jury of men conversant with the subject were summoned, should conceive the present system might be preferable to any board of commissioners; it would give more public satisfaction than any such board. Specifications are not now sealed in America; but they used to be so previous to 1790, when, in consequence of the pernicious operation of the practice, it was abandoned. The public were not able to know whether a person had a patent or not: a man asserted he had, and there were no means of *determining* the fact. In Austria, at the present day, specifications are sealed; but when in Vienna lately, heard it continually spoken of as a grievance. Conceives that the specification should be always open; and farther, that it should be the first thing, as witness believes it is in all countries, except England, as perfect as the inventor can make it in the first instance, but open to amendments at any time during the fourteen years.

8th June, 1829.

Mr. John Farey, again examined.

Delivered in, 1. A List of Acts of Parliament and Decisions of Courts of Law relative to Patents. 2. A List of the Patents granted in each year since 1796. 3. An edition of the Foreign Laws of Patents, in French, with a manuscript translation into English of the American, French, Belgian, Austrian, and Spanish Laws (all of which are printed in an appendix).

Believes that there are many secret inventions of value which it is not the interest of inventors to disclose, under the present system; and that individuals often endeavour to realize the whole profit of a very small extent of business, for as long as they can preserve their secret, rather than look to a small share in the profit on a very extensive open practice for fourteen years, under a patent. For instance, Dr. Wollaston had a mode of preparing malleable platina, which he practised in secret for a long time, and only disclosed on his death-bed—probably very imperfectly. Mr. Watt invented and made a machine for executing sculptures which he never disclosed, any further than as the machine which he left behind him may have explained itself. An ingenious mechanic at Sheffield, named Gilpin, had a machine for cutting the teeth of cog wheels, and another for making hard steel spindles for cotton spinning; the works he produced by them were most excellent, but he kept the means secret, and witness does not think they have been practised with any success since his death. Independently of the risk of such secrets being lost altogether, it is a great public loss to keep them locked up; for they cannot be extensively practised in secret, and the possessors must lay a very heavy tax on the little business they do execute in secret with their own hands: the processes too would be more likely to get improved if they were made publicly known, and new appli-

cations of the inventions would be made, which cannot be made whilst they are kept secret. Thinks that (besides amending the law so as to lessen the inducements to secrecy) public purchases of many inventions should always be contemplated, and that a fund should be provided for the purpose. Conceives that the protection of a patent right is decidedly calculated to render new inventions more generally known and used; and is of opinion that many great inventions would never have been brought to bear as they have, but for the encouragement afforded by a patent. Mr. Watt's steam-engine may be quoted as a great example. Considers that the public derive benefit even from patents for trivial inventions, such as snuffers, stirrups, corkscrews, &c.; for by the operation of patents, the making and vending of patent articles, which have merit enough to sell, is multiplied and accumulated into considerable trades, which would never have arisen to any such extent without patents, because no individuals would have devoted themselves to have created such trades, if others could have supplied the demand as freely as themselves when created. Having been cultivated under a patent, and established as distinct trades by interested patentees, such trades continue to be permanent after the expiration of the patents; that is the origin of a number of considerable trades at Birmingham and Sheffield, and in London. Is not aware of any serious inconvenience having arisen from the refusal of patentees to grant licenses; for a person so refused can always practise the invention without a license, and the patentee could not, it is believed, recover in that case more than nominal damages from him. Conceives that any provision for compelling patentees to grant licenses at a price to be fixed by arbitration, would do more harm than good. Is confident that the best way is to leave patentees full liberty to use their rights as they think best. From witness's experience in the proceedings of courts, he has not been inclined of late years to complain of the administration of the patent law by judges and juries, when it has become known what that law is, and when sufficient evidence has been tendered. What witness sees reason to complain of, is the obscurity of the law; the difficulty of knowing what it is; the manifest injustice of many of its provisions, when expounded by the judges, who often acknowledge its hardships, and the excessive expense of stating a case in the prescribed form, so as to enable the court to really decide according to the law. Witness's own opinion is, that when sufficient trouble and expense have been gone to, to make the subject intelligible to the courts, they examine very patiently, and decide so as to leave no reason to complain of judges and juries, but ample reason to complain of the law. Considers the practice of granting patents for inventions imported from abroad of decided advantage. We have derived almost as many good inventions from foreigners as have originated among ourselves. The prevailing talent of the English and Scotch people is to apply new ideas to use, and to bring such applications to perfection; they do not imagine so much as foreigners.

12th June, 1829.

Thomas Aspinwall, Esq., Consul of the United States of America in London, examined.

Described the American law of patents. The chief points in which it differs from the English are, 1. That the specification must be lodged before the patent is granted. 2. That the whole proceedings may be completed, and a patent obtained in one day. 3. That after a patent has existed three years unchallenged, the patentee cannot be called upon to defend it by any process in the nature of a *scire facias*. 4. That a patentee can dispose of his right to any number of persons, and to any body, without limitation; it descends also to his heirs; and if an inventor dies previously to securing a patent, his heirs, and even his executors, have a right to take out the patent after his death in the name of the executor or administrator. 5. That patents are not granted in the United States to foreigners unless they have been resident for two years, or have obtained a special Act of Congress in their favour. 6. That a foreigner applying for an American patent is obliged to make oath that the invention has never been made known or used in any foreign country; and, 7. that there are no patents of importation.

Can you state whether from the cheapness of patents in America, a very great number are taken out?—About 200 annually.

Is the number found to be any inconvenience, or there any complaint

of the number of patents that are taken out?—Not at all.

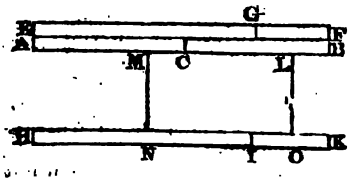
Is 30 dollars the whole expense?—All the official expense. The party may possibly go to a lawyer to have his petition drawn up, and to have his papers put in proper order, for which the highest rate of compensation is about £4. 10s.; so that the whole expense of a patent seldom exceeds about £11. or £12.

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

(Continued from p. 343.)

There is a method for proving the principles of the common lever, introduced, according to some, as early as the time of Archimedes, but certainly not later than that of Galileo: it is thus—

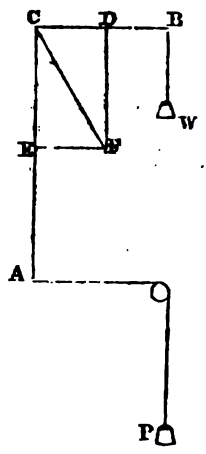
Fig. 1.



Let AB represent a perfectly uniform bar, suspended by its centre C. Upon this lay another bar, EF, of exactly the same length; it will still be in equilibrium. Again, if this bar be divided into two parts at any one point, viz. G, it will still be at rest. Now the centres of gravity of those two parts will be at their centres of magnitude, as they are perfectly uniform; consequently, if these two parts are suspended from the points on which these centres were pressing, (viz. M and L) by strings fastened to the centres of gravity N and O of the two parts HI and IK, they will still be at rest; and it is evident that the bar HI is to the distance IO, as the weight IK is to the distance IN, and which are exactly the same proportions as were before given.

It is not requisite that the lever be straight; the same principles will apply with regard to those that are bent. Let ACB be a lever, whose fulcrum is at C, and let the weight W=20lbs. be suspended from a point B, at a distance of 4 inches from C; consequently the weight has a tendency to produce motion equal to (20×4=)80. Now let the power equal to 5lbs. act on a point A, at a leverage AC=16 inches, therefore its tendency is 5×16 =80, which is the same with that of the weight, consequently they are in equilibrium. The pressure on the fulcrum is not the same with either of the former kinds of lever, it is found in the following manner: on the line CB (fig. 3) take a part CD, in the same proportion to the opposite force P, as a part CE of the line CA bears to the weight W; and by completing the parallelogram CDFE, the diagonal CF will bear the same proportion as the pressure exerted on the fulcrum. A hammer when drawing a nail is an instance of this kind of lever.

Fig. 2.



The same principles also apply whatever number of forces are applied. If the several forces, having a tendency to turn the lever round in one direction, be multiplied into their distances from the centre, and their amount be equal to that of the forces acting in the opposite direction multiplied into their distances; and if they are equal, the lever will be in equilibrium. To calculate the pressure exerted on the fulcrum, add all the forces downwards; and from this sum subtract the sum of those acting upwards, and the difference will be the pressure.

When the weight of the lever itself

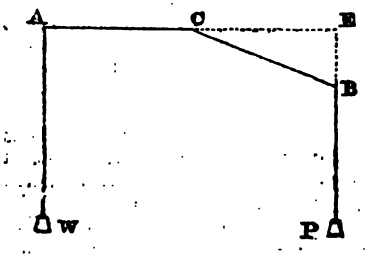
is to be taken into account, the rule is to find the centre of gravity of the beam; and from this point imagine a weight to be suspended equal to its weight, when the effect may be easily found by the last rule.

In practice, it is generally usual for the weight of the lever to be made to favour the power.

The next varieties of the lever are these—

First, when to a lever the forces are applied obliquely to their arms. Let AB be the lever, the fulcrum

Fig. 3.

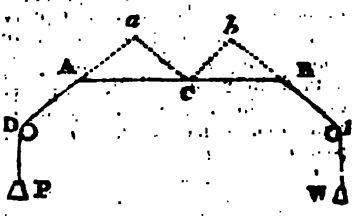


of which is at C, and let the power P act on the oblique arm CB, and the weight W act at right angles to the lever, as AW. Now the tendency of a body to turn a lever round a fixed point, is found by multiplying the force or weight into the length of a line drawn perpendicular to the direction of the force from the centre; but CB is not perpendicular to BP, consequently the line PB must be continued to E, from which point the perpendicular EC must be drawn; and the tendency of P to produce rotation, will be found by multiplying the weight P by the line CE, and not by CB. This rule is applicable in every case; and is this, that the *perpendicular* distance of the centre from the line of direction multiplied by the weight will give the tendency of that weight to produce rotation.

But even in this case the power and weight are still acting parallel to each other: the next case for consideration is, when they are not so.

Let AB be the lever acting on the fulcrum C, and let the power P and the weight W act in the oblique directions AD and BI, by means of *strings* passing over the pulleys D and I. Now the same principles apply

Fig. 4.



in this case as in the last; viz. multiply the quantity of force by the perpendicular distance of the line of direction from the centre. But CB is not perpendicular to BI (the line of direction), therefore that line must be continued to a point *b*; from which point a perpendicular line will meet the fulcrum *c*, therefore the weight W must be multiplied by the line C*b*, which will give its tendency to produce rotation in the same manner: the effect produced by the power P is found by multiplying it, not by the arm of the lever CA, but by the perpendicular distance C*a*; and if these two effects be equal, the lever will be in equilibrium.

When there is only one axis it is a simple machine, however many resistances or powers there may be, or in whatever directions they may act; but when there is more than one fixed axis, the machine becomes compound.

(To be continued.)

ON FLYING.

Sir,—Several articles on flying, by different authors, having appeared in your miscellany, every one of which being most certainly insufficient, there needs no apology for making some strictures thereon. Your correspondent M., No. 287, p. 447, is entitled to be first noticed, as he announces that "the art of flying in the air in every direction by purely mechanical means" "has at length been achieved!" and that circumstances [not of a selfish, but] of a personal nature render it necessary that he should dispose of a fourth share of "the incalculable pecuniary profits of the discovery" for £1500. Now, the probability or improbability of the attainment he

announces may become tolerably clear by an inquiry respecting *the force actually necessary to accomplish so desirable an object*; and which I shall endeavour to render perspicuous in the course of my remarks on the several methods proposed. As to the present case; if the fact were really as this correspondent has stated, why has he prefaced the announcement by an expostulatory appeal? Or why does he complain of the incredulity of the human mind? It can be of no avail to use arguments in a matter wherein public credence can only be obtained by the fact being shown. The exhibition of a thing so novel and of such importance to mankind, must not only put down unbelief wherever such an act of flying may be performed; but, as the subject is of a nature to excite the most eager attention, the tidings of such an attainment would spread with the greatest rapidity, and be speedily carried to the utmost bounds to which intercourse extends. He adds, that he has "succeeded in the construction of the necessary parts and materials, far excelling in the requisite qualities of strength and lightness any thing produced by nature." But what does this imply? Does he mean to say that those parts and materials can be put in motion so as to excel in flying any thing produced by nature? Certainly not; and I must avow myself to be one of those incredulous persons M. complains of. I cannot believe that either he or any other person has discovered the art of flying, notwithstanding his announcement: since it is obvious that flying can only be effected by a very rapid and incessant motion of wings or vanes beating upon the air; and that the beating must be performed with a vehemence sufficient to create a resistance equal to the weight to be sustained, while the power which is to produce such motion must necessarily be applied to a part of the machinery when the motion is much slower, so that a force will be required far exceeding what is in the power of man to exert. The principle is unavoidably that of the inverted order of the lever, wherein the power is applied near the fixed point, while the weight is sustained by the end, as I shall endeavour to unfold in a future Number, whence the required force will be easily ascertained.

I am, Sir,
Yours, &c.
J. H.

Barton-upon-Humber.

(To be continued.)

DECOMPOSITION OF WATER.

Sir,—A friend of mine having purchased a small galvanic battery, consisting of twelve pairs of 4-inch plates, arranged on the principle recommended by the late Dr. Wollaston, I was desirous of ascertaining its power; and for this purpose I endeavoured to decompose water by its agency, convinced in my own mind that if a battery of that small number of plates would effect the decomposition of that liquid, most authors who have written on the subject must have been mistaken on the intensity of a battery required for that purpose. Two glass tubes, three-eighths of an inch in diameter and three inches long, were fitted with corks, and platina wires passed through the corks to the bottom of the tubes; the tubes were filled with water, and placed in a glass containing the same fluid. On making the circuit of the voltaic electricity by connecting the poles of the battery with the platinum wires, exceeding minute globules of gas were seen to rise in the tubes; and it would have taken the action of the battery for many hours to procure sufficient gas for the purpose of determining its properties. We were anxiously watching the experiment, when, by accident, I poured a small quantity of dilute nitric acid into the glass containing the tubes,—immediately great quantities of gas were seen to rise in both the tubes. Could this increased action of the battery be caused by the nitric acid? was our immediate inquiry. A small quantity of pure nitric acid was poured into the glass, and again the power of the battery was considerably augmented, so much so that the tube in connexion with the negative pole was filled with gas in the space of a few minutes. We then applied the usual tests to

discover whether we had obtained the competent parts of water, or any other gases; but on applying a lighted taper to the tube containing the gas evolved from the negative pole it instantly inflamed, and a small piece of lighted wood inserted in the other tube burnt with increased rapidity. This was a convincing proof that oxygen and hydrogen were procured by the decomposition of the water. But was the acid the means of increasing the power of the battery, or did it decompose the acid? I am convinced the acid was not decomposed, for during the whole time of the experiment the volume of the gas at the negative pole was double that at the positive. If the acid had been decomposed, we should have obtained two and a half volumes of oxygen and one volume of nitrogen; instead of which, two volumes of hydrogen and one volume of oxygen were the result. I must then conclude, that in some way or other nitric acid does assist the decomposition of water by means of the galvanic battery.

L. RICHARD.

Southwark,
Jan. 2, 1830.

ON THE EFFECT OF SALT IN DISSOLVING ICE.

Sir,—The common table-salt having lately been recommended to produce the easy removal of snow and ice from the pavements, a few remarks on this property of the muriate of soda may not be altogether unacceptable to numerous readers of your valuable journal.

Many have, no doubt, been too sceptical either to try the experiment, or to treat it as a chemical fact, depending upon that hygrometric quality which this and other salts possess when the base is an alkali. Those salts which have an affinity for moisture, so powerful as even to liquefy in our atmosphere not to our feelings sensibly damp, and the solutions of which do not so readily part with their moisture, as to allow the aqueous particles to freeze in a climate like ours, at the severest seasons must, when strewed in a dry crystalline state upon ice, exercise a very energetic influence upon the composition of the congealed water, in consequence of the superior affinity we have applied to; and this action will be more rapid and more effectual on ice than on snow, owing to the porosity of the latter preventing the atoms of the two bodies from coming into close contact. A portion of salt may lie on a piece of trodden snow for hours before traces of either are lost; but it is quite otherwise when ice is substituted; then the salt has a dense mass to act upon, and in a short space of time the surface is covered with a strong brine. When sulphuric acid is exposed to intense cold, it is not the acid but the water that freezes; and the same principle holds good with the sea-water in the northern regions, or wherever it is found frozen over, for the ice when dissolved produces fresh water suitable for ordinary purposes on board ship, and is even made use of in the culinary operations.

Marine salt as it dissolves the surface of the ice is attended with a slight crackling, occasioned by the contraction of the ice as it enters into solution. If the experiment be made on a thin coating of ice or frozen snow on a flagged foot-walk, liquefaction soon takes place wherever the salt has fallen, but spreads slowly, and does not loosen the ice, as some may be led to imagine, so as that it might be removed in broken lumps; it is the dissolved parts only which can be swept away, and to carry this artificial thaw to any extent requires a large quantity of salt.

I am, Sir,
Yours truly,
H. D.

Stepney, Jan. 18, 1830.

INTERIM NOTICES.

Communications received from S. P. W.—J. H.—a—Mr. Foord—W. H. B.—T.—Henry D.—Mr. Thirlwall—Mr. Snooks—Dale—Mr. Shores—R. H.—Lector.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 338.] SATURDAY, JANUARY, 30, 1830. [Price 2d.

A CASH-REGISTER.

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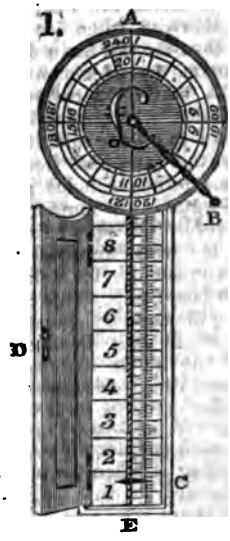

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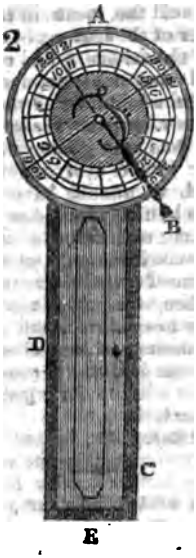

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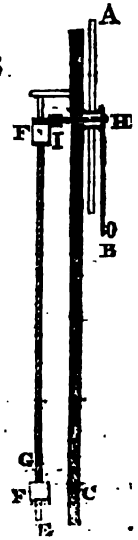

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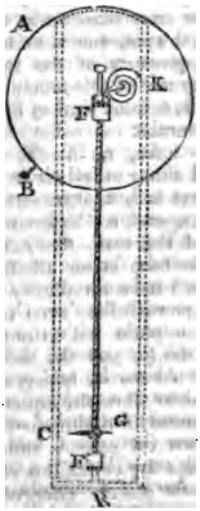


A CASH-REGISTER.

Sir,—To protect tradespeople from the frauds to which they are ever exposed in the keeping of their accounts, as well as to afford those who are not in the habit of making written statements, a means of ascertaining their daily receipts, a mechanical register would be found of the utmost service. In proof of this, were it necessary, many different kinds of establishments might be named where a considerable number of small payments are deposited in the cash-drawer, without any account whatever being taken of the items. The difficulty of using the pen on every occasion, and the increased number of cash books that would be required, are in themselves very great obstacles in almost every retail business; so that the temptations thrown in the way of persons holding responsible situations are likely to continue, and the interests of tradesmen and others to remain unguarded, unless some speedy method be adopted for registering all money received.

The cash-register, delineated in the prefixed engraving, is one which requires no farther trouble for setting down the most trifling sum, than the mere turning of a hand or index to the required amount, as expressed on a circular scale: this simple operation registers on another scale, enclosed in a locked case, the sum total. The following are references to the several diagrams of this machine:—

Fig. 1, a front view of the register; A, a circular moveable scale, with a hand or finger, B. The scale is divided into a small circle representing one pound, a larger one for twenty shillings, and a third circle on the edge of the card, every division of which stands for one penny, making together two hundred and forty pence. C, a case with the door D, opened to expose a scale with three columns graduated for pounds, shillings, and pence. Above E, and central in the scale, there is a perpendicular screw, having a very fine thread cut on it; on this screw (between C and the figure 1 on this scale) there is a small index, which, having a female screw, ascends, according to the number of revolutions given to the upright screw, by the pinion and wheels, when affected by the motion of B: which wheels, &c. may be seen in the section Fig. 3, and also in Fig. 4. The hand B is on the seven-shilling division of the circles.

Fig. 2. This figure represents the case closed up, and the circular card, turned so as almost to reverse the central letter, or sign for pounds. It was before mentioned, that in fig. 1 the finger pointed out seven shillings: now as it would be awkward to add another sum, by commencing to count from the 7 (or, which is the same, the 84), the scale is made moveable, and without affecting the pinion of the hand, as will be seen hereafter, by this means the lowest figure is brought under the finger, and every fresh calculation begins at the unit. If the scale has more divisions than for one pound, the diameter of the circle should be proportionably increased, otherwise the minuteness of the numbers might lead to continual errors.

Fig. 3, a section of the register. The screw E has two cogged wheels, F F, at each end, for the convenience of reversing it when the index at G has ascended its full height. The wheel F is put in motion by a smaller wheel, or endless screw, I, fixed to the pinion H of the hand B. The pinion H works through a short tube fitted to the wooden case c; and it is on this tube that the card A is made to revolve.

Fig. 4 represents the back of the machine, chiefly to show a small click and spring, K, acting upon the cogs of the pinion-wheel, preventing any other movement being given to the hand B than from right to left. G, the index. The other references are the same as in the three preceding figures.

In fitting up a machine of this kind, it is not material whether the circular scale be placed perpendicular or horizontal; it is probable, however, that the last would be the most convenient position. I now beg to remain,

Sir, your obedient servant,

HENRY D——.

Stepney, Jan. 1830.

ON FLYING.

(Continued from p. 399.)

Sir,—J. K. of Ripon, in replying to your correspondent M., observes, (No. 295, p. 128.) that he also has made the art of flying his study; but that he has sought to accomplish it by imitating, not excelling nature. I beg, however, to dissent in opinion from J. K.; for at the same time that I consider it utterly impracticable, I conceive its accomplishment to be far more probable by not imitating than by imitating nature. In constructing land-carriages in the primitive ages of the world, it perhaps never occurred to make them with four legs to imitate animals in travelling; and just as different are my ideas respecting imitating the wings of birds in flying: in short, I think with W. C.* (No. 240), that a rotary motion of the wings or vanes is far more likely to effect this desideratum than that of reciprocation. But my method is very different from that of W. C. Instead of the axles being horizontal, as he has described, I consider a vertical position for them greatly preferable, with the vanes fastened to arms at the upper ends of the axles—those vanes having proper angles varying in every part according to the distance from the centre. For such a purpose there must be two axles, each furnished with vanes, the one to revolve the contrary way to the other; otherwise, in giving motion to only one set of vanes, a whirling motion in the contrary direction must inevitably be communicated to the car; but such tendency is done away by having two sets, the one moving reverse to the other. The power of flight generated by the motion of such vanes will be in the direction of their axles, and therefore when the car is so balanced that the axles are exactly vertical, the effect is to lift the machine directly upwards; and by the person in the car moving so as to give them a little inclination, a progressive motion would be effected in the direction of their inclination. It would be an easy matter to connect those axles with any motive power (as a steam, or a rarefied-air engine), and with each other in a most simple and much lighter manner than by wheelwork; but as I am apprehensive that *the weight* of any engine on any principle hitherto known would be greater than *its power of ascent*, I have no hope of success; and I have observed in my reply to M. that the strength of a man is altogether insufficient to sustain his own weight in the air in such a machine. If man had fifty times his present power with only his present weight, it is not improbable but means of flying might be effected; but certainly not much less than fifty times the strength is necessary to fly with ease and safety. Had I the most distant prospect of such an attainment; or were there any probability of its being promoted by any thing my ideas might suggest, I would give a sketch of such apparatus as occurs to me: but conceiving its accomplishment to be impossible, such sketch might reasonably be considered both useless and obtrusive. J. K. seems to consider weight no great hindrance to flying; I believe he will find it such an hindrance as he will not be able to surmount: for which reason I take the liberty to intimate, that he perhaps may as well not be too precipitate in incurring the expense of a patent. He is evidently wrong in supposing that any perceptible diminution in the effect of gravity can be gained by velocity of progress. For though it be true that "when any body gets *sufficient velocity* it overcomes its gravity;" yet it ought to be considered what is the velocity that is *sufficient* for this purpose? Any reduction in the effect of gravity is only attainable on the principle of the centrifugal force occasioned by the rotation of a body in a circle round the earth, and which is only equal to gravity when the body moves at the amazing rate of about 8650 yards in a second, or 295 miles per minute: of course, the reduction to be obtained by the greatest velocity that can be supposed acquirable in flying, will be too trivial to make any account of.

J. H.

Barton-upon-Humber.

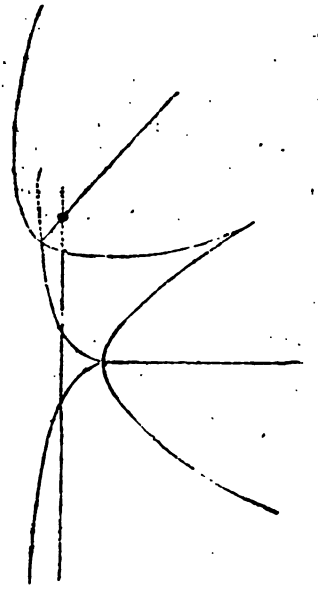
* The late Sir William Congreve.—Ed.

(To be continued.)

MECHANICAL GEOMETRY.—MR. JOPLING'S SEPTENARY SYSTEM.—MR. CHILD'S PARABOLIC TRAMMEL.

Sir,—I have already informed you that I have reason to think that all the lines of the first division are the epicycloids of the lines of the cusps; and now I believe I may say the same thing of almost every other division. Under the article "Epicycloids" in "Rees's Cyclopedia," it is stated, that "if a parabola be made to revolve upon another equal to it, its focus will describe a right line perpendicular to the axis of the quiescent parabola:" (see fig. 1.)

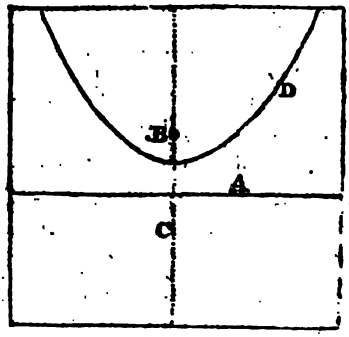
Fig. 1.



"the vertex of the revolving parabola will also describe the cissoid of Dioeles; and any other point of it will describe some one of Newton's defective hyperbolas having a double point in the like point of the quiescent parabola." And in the same work it is stated, that the "invention of the method of describing the cissoid by the continued motion of a square ruler is ascribed to Sir I. Newton." I cannot, however, find that it has *hitherto* been known, that the motion *of a plane* carried by the revolving *parabola is* identically the same as the motion of a plane regulated by the square ruler with the cissoidal motion; or that the cissoidal motion will produce the defective hyperbolas of Newton; or that any enumeration of the various lines generated by such a motion has been given.

In the septenary system the plane in motion is always considered to be connected with or regulated by a plane at rest. With the cissoidal motion the plan of each plane is represented by

Fig. 2.



which may be supposed to be a plane infinitely extended in every direction. A is the directing right line; B is the pole, and also the focus of the parabola D, which is the line of the cusps; C is the line of symmetricals.

Fig. 3.

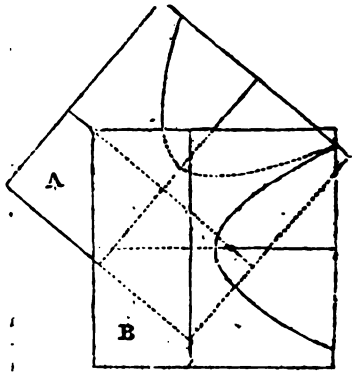


Fig. 3 shows two of these planes connected together, which exhibit at one view both the cissoidal motion and also the epicycloidal motion of the parabolas.

As the elements for regulating the

motion are the same on each plane, it is, of course, not material to which the describing point is fixed. If the epicycloïdal motion of the parabolas be only considered, the focus on B will describe the directing right line on A; and the focus on A the directing right line on B. Consequently, if a directing right line and a pole in the focus be fixed upon each plane, these may be substituted for the parabolas, and either plane will have the same motion. The several lines which may be generated by points upon either plane may be enumerated as follows:—

First. The focus or pole describes a right line, which is uniformly symmetrical, and a line of the first order.

Second. The apex of the parabola, or a point on either plane midway between the pole and directing right line, will generate the cissoid, which is a cuspidated line in two parts symmetrical with infinite branches. This is a line of the third order.

Third. Any other point upon the periphery of the parabola, or line of the cusps, will produce an oblique or dissymmetrical cuspidated line. The farther the describing point is from the vertex, the greater the dissymmetry of the two branches will be. These lines are called defective hyperbolas by Sir I. Newton.

Fourth. Any point upon the axis of the parabola, or that part of the symmetrical line within the parabola either above or below the focus, will draw an oblate symmetrical line.

Fifth. All other points within the parabola, or line of the cusps, will describe dissymmetrical oblate lines.

Sixth. Any point on the other part of the symmetrical line, or the produced axis of the parabola, will draw a symmetrical cuspidated line.

Seventh. And all other points of the plane beyond the parabola, or line of the cusps, will generate dissymmetrical nodated lines. The nodes will be the greater the farther the describing point is from the line of the cusps; and their dissymmetry the greater the farther the point is from the directing right line, and on that side of it which contains the line of the cusps.

Or the enumeration may be thus briefly stated:—

First. The right line.

Second. The symmetrical cuspidated line.

Third. Dissymmetrical ditto lines.

Fourth. Symmetrical oblate lines.

Fifth. Dissymmetrical ditto.

Sixth. Symmetrical nodated lines.

And,

Seventh. Dissymmetrical do. do.

Although the five last descriptions of lines are infinite in variety, those terms comprehend the whole; and I offer this as another proof of the possibility of forming a complete classification of all the lines in the septenary system.

Either plane may be supposed to be divided by the line of the cusps into two fields, both of which are infinite: but the one producing the oblate lines may be called the *interior field*, while the other which describes the nodated lines may be called the *exterior field*. And either plane is divided by the line of symmetricals into two equal and respectively similar parts.

It may perhaps be proper to state that any two points upon any line crossing perpendicularly the line of symmetricals, and at equal distances from it, will always produce lines respectively symmetrical, whether oblique, oblate, cuspidated, or nodated.

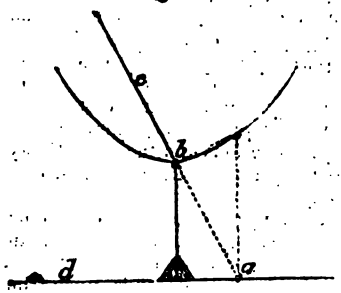
It may also be proper to observe, that while the epicycloids of the hyperbolas are *finite* lines, those of the parabola are *infinite* lines.

Portions of these lines, as well as those of many others, are beautifully described by an apparatus which I have called "The Nichomedean Rulers."

Mr. Child has had the kindness to send to me for inspection one of his parabolic trammels, which exhibits a proof of his early ingenuity. It is indeed the same in principle as the one of which you have published an engraving, and on which I ventured to make a few observations.

In both Mr. Child's trammels, the simple principle on which they are constructed is by the multiplicity of pieces not readily perceived. It is, however, simply as in

Fig. 4.



and the line which it generates, is the line of the cusps on one of the planes in that class of the fifth division which produces the conchoids. The line of the cusps on the other plane is represented by A,

Fig. 5.

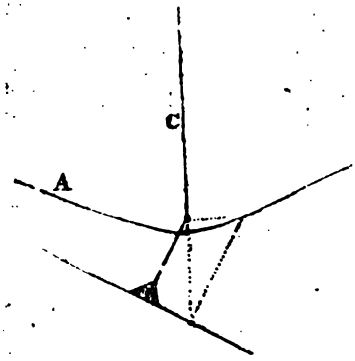
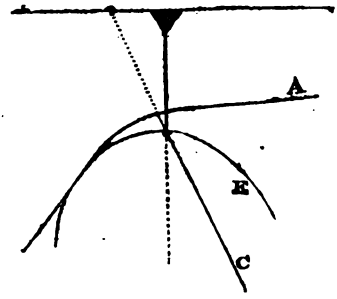
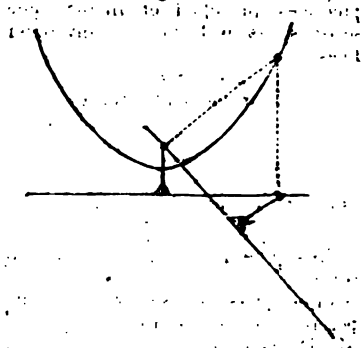


Fig. 6.



In fig. 6 the line of the cusp in fig. 5, marked A, is represented rolling on the *line of* the cusps on fig. 4, marked B, by which motion the conchoids will be produced; which shows that all the conchoids are epicycloids of those lines of the cusps; both of which are parabolas. That shown on fig. 5, or A, fig. 6, continually approaches an assymptote, which is perpendicular to the axis C, at an infinite distance from the apex.

Fig. 7.



when compared with fig. 4, will show the difference between the conchoidal principle, on which Mr. Child's apparatus is constructed, and the cissoidal principle. In figure 4, the poles *a* is in the produced directing right line *c*; and the pole *b* is at a distance from the directing right line *d*. In figure 7, both poles are at an equal distance from the respective directing right lines. In both cases, in whatever position the poles may be, perpendiculars to the directing right lines at those points will intersect in the periphery of the parabola. In fig. 7, the pole and focus of the parabola coincide. In fig. 4, the pole is at the apex, and the focus from the apex is $=\frac{1}{4}$ of the distance between the pole *b* and the directing line *d*.

An enumeration of the lines produced by the conchoidal motion will be something like that for the cissoidal motion; but the reverse of the conchoids, or those produced by rolling B against A, fig. 6, as well as the intermediate cases between that and the cissoids, will require a very different classification.

Knowing that the ellipse and hyperbola were lines of the cusps in the first division, I ventured to state (vol. viii. p. 437), that I thought all the conic sections and the lines of the third order enumerated by Sir I.

Newton, and others, would be found. Although I have now reason to believe that the lines of the cusps in the first division do not include the whole of the conic sections; I am satisfied that the whole are to be found in the lines of the cusps in the Septenary System, which it is interesting to find produces epicycloids of all the conic sections, as well as of many other lines.

I am, Sir,
Your obedient servant,
JOSEPH JOPLING.

DRURY'S IMPROVEMENTS IN BELL-RINGING.

Sir,—The communication of your correspondent C. H. in your last Number, has apprised me of an important omission in my description of Mr. Drury's improved mode of fixing and striking church-bells, at p. 282. I should there have stated, that the same principle can be applied to bells already hung with great facility, and Mr. Drury is prepared so to apply it.

As I before stated, many of our steeples are in such a dilapidated state, that it has become dangerous to ring the bells which they contain, and many others are fast approaching towards the same condition. In the first of these cases, it is absolutely necessary—if the music of the bells is to be retained—that Mr. Drury's mode of ringing should be immediately adopted; in the latter, the same course is dictated, both by motives of safety and economy.

The parishioners of St. Mary-le-Bow were some time since in communication with Mr. Drury on the subject of their bells: and although they then declined having their peal recast upon the improved principle, yet they should certainly apply the new mode of striking to the bells, which now hang mute within their steeple—the only course which will ensure the future safety of the edifice, with the continued harmony of the peal, to the delight of every true Cockney.

The mode of applying the *new principle of striking to old bells*, is tolerably well illustrated by fig. 1, p. 361. The plan, fig. 2, same page, if adopted, would produce no better sound from the bell than the inferior one now obtained by *clappering*.

With regard to the "hope," expressed by your intelligent correspondent, "that so important an improvement will not be suffered to expire in diagrams and theory"—I may observe, that Mr. Drury is a PRACTICAL MAN, and one not likely to give up that, which, after so much trouble and expense, he has succeeded in bringing to perfection.

All, however, depends upon the PUBLIC; if they are willing to discontinue the present waste of human labour, and to remove the risk, which in so many cases now exists, of bringing down the steeples about their ears—let them avail themselves of the ingenuity and skill which offer such a simple, inexpensive, and effectual remedy.

At some future time I hope to have the pleasure of laying before your readers some of the investigations of Mr. Drury, on a subject of great importance to the musical world.

I am, Sir,
Yours respectfully,
WM. BADDELEY, Jun.

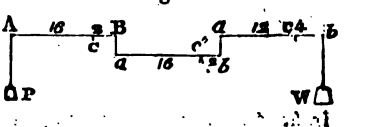
Jan. 20, 1830.

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

(Continued from page 398.)

The compound lever is the most simple of all the compound machines. Fig. 1 is an instance of this machine, where equilibrium is produced in three levers, by 4 lbs. placed at one extremity, A, and 768 lbs. at the end of the third lever, viz. b. There are in this figure three levers: the first,

Fig. 1.



A B, resting on the fulcrum C; the second, a b, resting on c' and the third, a b, on the [illegible] P, equal to A, is suspended from the

point A, at a distance from C of 16 inches; consequently, the force exerted in an upward direction at B, distant from C two inches, is equal to 32: this force is communicated to the lever *ab*, by means of a string fastened from B to a point *a*, 16 inches from *c*''; therefore a downward force is produced at the point *b* (two inches from *c*') of 256: which force is again transmitted, in the same manner as before, to a point *a* (of the lever *ab*), 12 inches from the fulcrum C, and which will therefore keep in equilibrium a weight W, equal to 768, acting at a point *b*, at a distance of 4 inches from *c*.

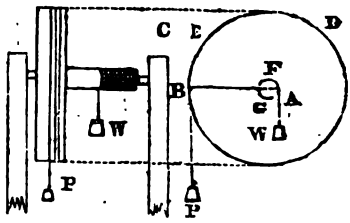
There is another way of expressing this. Take the length of the three arms presented *towards* the *weight* which multiply into each other: do the same with those *towards* the *power*, and the two sums will be in inverse proportion to the weight and power. This may be mathematically expressed thus: $\overline{BC \times bc \times bc} : \overline{AC \times ac \times ac} :: P : W$: which is $\overline{2 \times 2 \times 4} : \overline{16 \times 16 \times 12} :: 4 : 768$, or $16 : 3072 :: 4 : 768$.

It is not necessary that they be all levers of the first kind: the same principles will apply whether they are of the second or the third, even or crooked, &c.

There are many defects attending the lever as a practical machine. First, where the power moves through a considerable space, the weight, on account of the different lengths of the arms of the lever, is moved through a very small space. Again, it is an intermitting machine; that is, the effect is not continual: for, in the instance of raising a block of stone, the weight is raised until the end of the lever at which the power acts has reached the ground, when the weight must be supported until the fulcrum is raised, and so on. To modify this intermission, and to continue the motion, the wheel was made use of; and when it is used, it is called the wheel and axle: in which form it has been by some called a separate mechanical power.

Fig. 2 is a side view, and fig. 3 a *section of this* machine; and it will *be only* requisite to prove its principles to be the same with those of the lever for its power to be known. (The same letters refer to each figure.) Let

Fig. 2. Fig. 3.

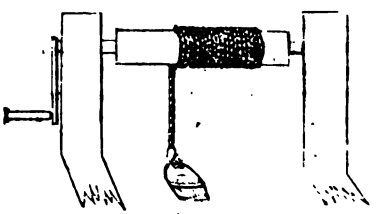


E D B be the wheel, and A F G the axle, having the common centre C. Now, by drawing the line A B in fig. 3, it is plain that it can be reduced to the lever A B, resting on the fulcrum C; the power P acting on the end B, and the weight W on the end A: consequently to find the effect of the power P to produce rotation, it must be multiplied by the radius of the wheel on which it acts. The tendency of the weight W is also found by multiplying it by the radius of the axle; and if these are equal, equilibrium must ensue.

The wheel and axle is liable to the same observation as the lever, that though a large weight may be kept in equilibrium by a small power, yet the power does not support the weight; it is the fulcrum or pivots which support them both.

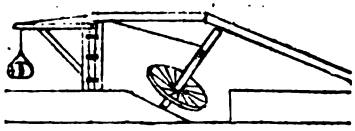
The efficacy of a force to produce rotation round an axis is found (as before stated) by multiplying it into its leverage, and the resistance is found in the same manner; and the whole efficacy of a machine is found by the surplus of the effect of the power over that of the weight, and it may be increased by either decreasing the leverage of the weight or increasing that of the power.

Fig. 4.



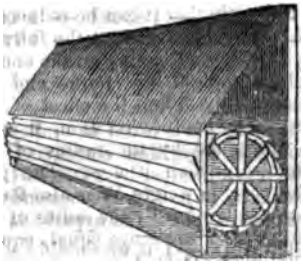
There are several ways of applying power to the wheel and axle; by a winch, as in that used for raising water from a well, (fig. 4.) by the weight of animals, as in the crane represented at

Fig. 5.



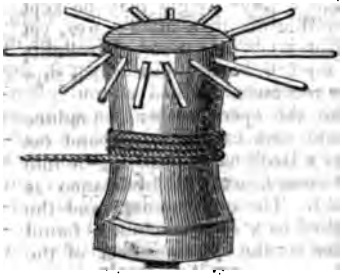
by the weight of men, as in the treadmill,

Fig. 6.



The capstan,

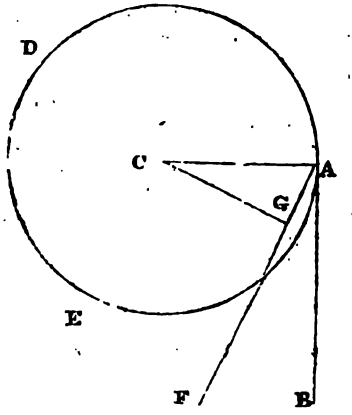
Fig. 7.



is an instance of this machine; only here the axle is perpendicular.

It will be evident that the power should always, when it can be accomplished, act tangentially to the wheel, for the force of the power is always estimated by its perpendicular distance from the centre. Let the line AB, fig. 8, represent a force acting tangentially to the circle ADE, and let AF be another force acting obliquely. Now, the effect of the force AB will be $\overline{AB \times CA}$, *(for CA is perpendicular to AB), and that of AF will be* $\overline{AF \times GC}$,

Fig. 8.



(for GC is perpendicular to AF), but GC is evidently less than CA; therefore the force AB acting tangentially is greater in effect than AF acting obliquely. In the same manner it may be proved that the power always has the greatest effect when it acts tangentially to the centre.

When the wheel is worked by a winch, it is generally attended with disadvantage: thus, if a man be the moving power, he is alternately stretching forward and pulling up; and the former being the much more effective position, the motion is very irregular. This is sometimes obviated by using two winches, one being at each end of the axle; or by two men working at the same winch; for when one man's power is at its maximum, the other is at its minimum, and the sum of these two effects at any position will be the same.

(To be continued.)

VELOCITY OF WATER IN PIPES.

Sir,—I thank your correspondent, Mr. J. Utting, of Lynn, for his early attention to my inquiry; and for his answer to it in your Magazine of yesterday, No. 336. He mistook my meaning, however, by supposing that the pipe had a *slope*, since the inquiry clearly stated that the pipe was horizontal; and I cannot think that it would matter much whether the insertion were into the bottom of the re-

servoir, or not. Mr. Utting has likewise mistaken the drift of the inquiry, by supposing that the quantity of water that would be discharged was sought; or that the discharging orifice was to be half an inch in diameter. Here is the marrow and substance, mind you; and hence Mr. Utting's solution (which though in one sense well enough, yet in a stricter sense is not right, inasmuch as Du Buat's formulæ are incorrect in many respects,) is not *the solution required*; because the velocity will mainly depend upon the *size of the hole* at the extremity of the pipe (or in the side thereof), at the respective distances mentioned. I now put the question in this way:—"All things being as specified in the inquiry (see "Mechanics' Magazine," No. 334), and the pipe plugged at the end farthest from the reservoir, then if in the side of the pipe, *within a few inches of the plug*, a small hole be drilled not exceeding the thirtieth (or from that to the twentieth) part of an inch in diameter, with what velocity will the water jet out, and to what height would it jet if the hole be vertical upwards, at the several distances assumed?" Every body knows that the velocity will diminish in proportion to the *increase of size in the hole*; and when the hole became half an inch in diameter, the result would be a degree of velocity not differing *very* considerably from Mr. Utting's statement, and yet in one sense differing *considerably* from it. And, as I have said before, a gradual slope all the way is *entirely out of the question*, and purely of *no moment*, or at least of *very little moment*, I am well assured.

Allow me to say, that I highly prize your Magazine, and have ordered it to be regularly sent after me as opportunity offers. I am, Sir, &c.

AQUEDUCT.

Upper Clapton, Jan. 17, 1830.

[It will be seen from the following letter, which we have received from Mr. Utting since the appearance of his answer to "Aqueduct's" question, that the use of the word *slope* for *length* was an error of the press; and that Mr. Utting is not unaware of the merely approximative character of *Du Buat's Tables*.—ED. M. M.]

DU BUAT'S TABLES OF THE VELOCITY OF WATER.

Sir,—In the "Encyclopedia Britannica," vol. xx. p. 653, is given a table, computed with considerable labour from the formula of the Chevalier Du Buat, for finding the velocity of water in pipes, canals, &c. As this table must be valuable to engineers, I shall therefore make no farther apology for introducing the following errata to your notice; viz.

$s=$	4·4 for	0·07898 read	0·07981
-	9·8 —	0·25186 —	0·28186
-	65· —	0·78276 —	0·77546
-	840· —	1·40678 —	1·40850
-	950· —	1·43464 —	1·43764
-	4500· —	1·77851 —	1·79851

In finding the hyperbolic logarithm of a number not contained in the tables, it is usual to multiply the common logarithm corresponding to the given number by 2·3025851. Dr. Robison, at p. 654, recommends that instead of taking the hyperbolic logarithm of $\sqrt{s+1\cdot6}$, we should multiply its common logarithm by $2\frac{1}{4}$; or multiply it by 9, and divide the product by 4: which process is vastly easier than taking the hyperbolic logarithm. Now, if the common logarithm of $\sqrt{s+1\cdot6}$ be multiplied by 2·3, (by the contracted method of multiplication) the operation will be quite as simple and easy as that recommended by Dr. Robison; and approximates 20 times nearer to the formula of Du Buat. The common logarithm multiplied by 2·3 may therefore be substituted for the hyperbolic logarithm, in all cases where it is involved in the formula of Du Buat, without sensible error.

I am, Sir,
Yours, &c.
J. UTTING.

Lynn Regis, Jan. 22, 1830.

Errata, vol. xii. p. 369.—In the answers to the second, third, and last queries, for "*the slope*" of the pipe, read "*the length*."

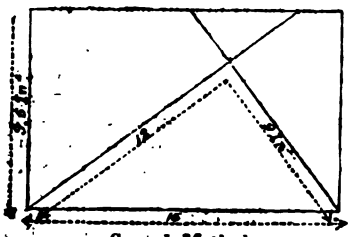
Line 27, for $\sqrt{s+1\cdot6}$), read $\sqrt{(s+1\cdot6)}$ (the left-hand branch of the parentheses being omitted).

SOLUTIONS OF THE MECHANICAL EXERCISE PROPOSED BY MR. LUCOCK, p. 251.

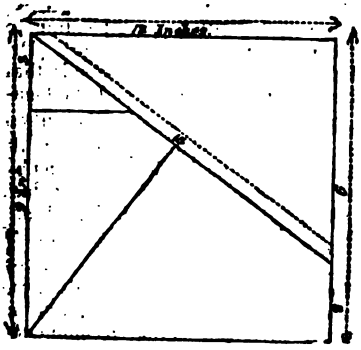
Case. A box exactly 12 inches square having lost its lid, it is proposed to make a new one out of a board 96 inches by 15. How can this be accomplished?

By Mr. Lucock, the Proposer.

First Method.



Second Method.



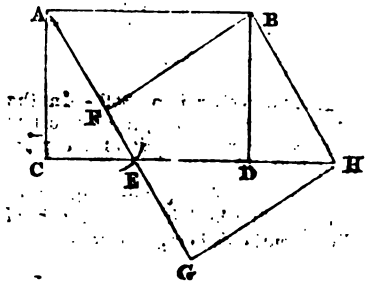
The same pieces cut from a card as a puzzle, will form another parallelogram 9 inches by 16.

L.

By Mr. Thomas Hughes, Pupil, Mansion House Academy, Hammersmith.

Let ABDC (fig. 1) be the given rectangle. It is required to cut it into parts, so that the parts may be joined so as to form a square.

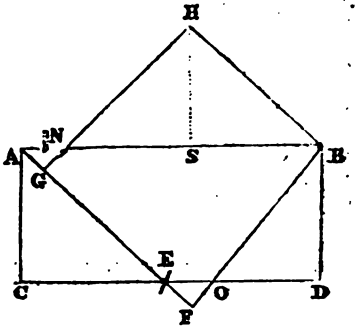
Fig. 1.



Construction. Find AE, a mean proportional between AC and AB, and from the centre A and distance AE, describe an arc cutting CD in E. Join AE, and draw BF at right angles with AE and BH, parallel to AE, meeting CD produced in H, and HG, parallel to FB, meeting AE produced in G. Then it is apparent that BFGH is a rectangle; also that the triangle ACE and BDH are identical; also since the angle GEH = AEC = FAB, and the angle HGE = BFA, each of them being a right angle, also GH = FB. ∴ the triangles EGH and AFB are identical. It therefore only remains to prove that BFGH is a square. Because the triangles ACE and AFB are equiangular AC : AE :: BF : AB, but by construction AC : AE :: AE : AB; hence AE = BF, also AE = BH. ∴ BF = BH. Consequently, BFGH is a square.

When the perpendicular BF meets

Fig. 2.



AE produced in F, upon BF describe the square BFGH. Draw HS perpendicular to AB, then it may be demonstrated as before, that AE = BF = GF. ∴ AG = EF, also the angle OEF = AEC = GAN, and the angles at G and F are right angles. ∴ the triangles ANG and EFO are identical. Again, the angle AEC = GAN = HNS = SHB, and the angles at S and C right angles; also HB = GF = AE. ∴ the triangles ACE and HSB, are identical, and HS = AC = BD, and by taking away the angle ABF from each of the equal angles HBF and ABD, there remains the angle HBS = OBD, and the an-

gles at S and D right angles, and HS =BD. ∴ the triangles BOD and HSB are identical; and thus the rectangle ACDB is divided into four parts, AGN, ACE, NGEOB, and BOD, which will coincide with the square HGFB.

[The shortest must, of course, be the preferable method of solving this problem; that is, the fewer cuts, and the fewer pieces, the better. Considered in this light, the solution of our clever young friend, Mr. Hughes, is by far the best we have received. He shows how by two cuts and the division of the rectangular board 9·6 by 15 into three pieces, the square board required may be obtained. Mr. Lucock employs also, only two cuts in the first of his methods, but the result is four pieces. None of our other correspondents (J. T. H., Mr. Gilbert, jun., Mr. Haverstock, J. O. B., and X. X.) who have favoured us with solutions of this case have proposed to use fewer than four cuts; one requires six, another nine. It is deserving, at the same time, of remark, that Mr. Hughes has shown that his method is one which will stand the test of the most rigid mathematical examination; thus exemplifying a truth which cannot be too often or too strongly impressed on the minds of our operative friends, that the most scientific mode of doing things, is at all times the easiest and best.—ED. M. M.]

A FEW MORE WORDS FROM "A PRACTICAL ENGINEER" TO MR. GILMAN.

Sir,—Your remarks at the end of Mr. Gilman's letter of the 4th inst. are so pertinent, and your advice to that gentleman "to grapple at once with the facts of the case," is so judicious, that I had better perhaps have left the matter in your hands; and I believe I should have concluded to have done so, had I not been accused of improper motives for writing my letter to you of the 17th of December, and of "acrimonious invective and personality" therein. I beg to assure you, Sir, that I know not Mr. Gilman at all, and that I never *saw* him in my life. How then *can I have been* guilty of *acrimonious personality*—"which (as Mr. Gilman truly states) is not argument; "only a proof indeed of conscious weakness!" Whether this accusation may not be retorted with more truth on himself, the reader will judge on perusing the few following lines. "Otherwise any *malevolent fellow* may raise a storm that may cause a great deal of trouble, and perhaps injure a man's character."—Mech. Mag. vol. xii. p. 351. Now, with all my acrimony and all my invective, I do not think the civil Mr. Gilman can find such uncivil language in all my former letter; although I do not deny that I may have *raised a storm* about his ears which may give him a *great deal of trouble*.

The fourth and fifth paragraphs of Mr. Gilman's letter contain some allusions to *the facts of the case*, but very slight ones.

"But the *joints!*" says Mr. Gilman, "aye, the joints! Did he never see such a joint?" No, Mr. Editor, I never did. "What a pity! Has he ever seen any thing of high-pressure steam? Perhaps not also." Yes, Sir, I have seen a *little* of high-pressure steam; and "when I want a cast-iron joint particularly sound," I, like Mr. Gilman, never trust to cemented flanges, nor do I trust to joints of not *one-half* of the width of 3-8ths of an inch, or not 3-16ths of an inch, when the vessel requiring those joints is (like the generator in question) two feet in diameter, whose area is consequently 452 inches, which, with 250lbs. upon the square inch, must sustain a pressure of 112,000lbs. or 50 tons! Mr. Gilman, Mr. Gilman, how can you have the effrontery to tell the public that you can show a hundred joints of those widths as sound as if they were of solid metal, and to affirm that "the bolts, even the bolts too, were really sufficient to confine, and actually did confine steam of between 200 and 300lbs. upon the square inch, and keep sound joints too." Let Mr. Gilman before competent witnesses show that with joints 3-16ths of an inch wide, and with twelve bolts he can confine steam in a vessel two feet in diameter of upwards of 200lbs. pressure upon the square inch, and then I will say we

ought to believe, without proof, all his other extraordinary assertions.

Now for Mr. Gilman's sixth paragraph; it is highly argumentative certainly, and ought to be taken, as the French say, *au pied de la lettre*. It may be divided into three parts; 1st. "But I have forgot the pipes; aye, they are uncovered and oxydising, but I must hasten to a conclusion." 2nd. "Did 'Novelty's' sore place suggest this idea?" 3rd. "I should have suspected him to have been one of those wot drives 'The Novelty,' &c. &c."

I am glad to find that, like a certain boastful knight, "I am not only witty myself, but the cause of wit in other men." I assure Mr. Gilman, I am not one wot drives 'The Novelty,' but he wot guards the *Im*position. All this and all the rest of Mr. Gilman's last letter is any thing but "grappling at once with the facts of the case;" and although this sort of badinage is by no means profitable, I see no other mode so proper of treating such an evasive epistle.

Hoping Mr. Gilman will adopt the excellent advice you have given him, and proceed to *grapple at once with the facts of the case*.

I am, Sir,
Your very obedient servant,
A PRACTICAL ENGINEER.

Note. In addition to the facts of the case, I wish to know when Mr. Gilman was practising the modifications requiring the pipe F to be fixed at the top of his generator (see his drawing, fig. 1), how he introduced the fuel into it. Was pipe F contrived (like Goldsmith's chest of drawers) "a double debt to pay?" Was it contrived to *em*it the gases and vapours, and to *ad*mit the fuel.

INTERESTING EXPERIMENTS BEFORE THE ROYAL SOCIETY ON RESISTING THE AGENCY OF FIRE.

At the weekly meeting of the Royal Society on Thursday, the 21st inst., Chevalier Aldini, of Milan (nephew of the celebrated Galvani), exhibited some remarkable experiments on resisting the agency of fire. The following account of them we extract from the "Literary Gazette:"—

"The Chevalier handled red-hot pokers as freely as he would walking-sticks; and also supplied asbestos gloves, by which such of the company as chose to make the trial were enabled to do the same. He informed the Society that he had succeeded in constructing an apparatus, or rather clothing, to preserve persons from injury who are exposed to flames; the efficacy of which had been proved at Geneva, where he showed the firemen that a finger, enveloped first in asbestos, then in a double case of wire-gauze, might be held in the flame of a spirit-lamp or candle for a long time before inconvenient heat was felt; and then clothing them gradually accustomed them to the fiercest flames. A firemen having his hand in a double asbestos glove, and guarded in the palm by a piece of asbestos cloth, laid hold of a large piece of red-hot iron, carried it slowly to the distance of 150 feet, then set straw on fire by it, and immediately brought it back to the furnace, the hand not being injured at all in the experiment. Another experiment related to the defence of the head, the eyes, and the lungs. The firemen put only on an asbestos and wire-gauze cap, and a cuirass, and held a shield before his breast. A fire of shavings was then lighted in a chafing-dish, and the fireman plunged his head into the middle of the flames, with his face towards the fuel, and in that way went several times round the chafing-dish for a period above a minute in duration. The Chevalier stated that he had an application before his Majesty's Ministers for a space of ground and adequate opportunities to exhibit his experiments."

The following interesting account of the material which figures so prominently in these experiments, we extract from the "Virginia Literary Museum:"—

Amianthus, a variety of asbestos, contains, per cent, about 59 parts of sand (*silex*), 25 of magnesia, and 10 of lime, besides traces of clay and iron oxide.—It is usually found in veins, and consists of fibres very flexible, and somewhat elastic. Friction readily re-

parates linen, and when dressed a little, they bear a considerable resemblance to fibres of silk or flax.

This filamentous nature, and the power of enduring a red heat, without any very apparent loss of substance, have long rendered amianthus celebrated among minerals. All its names are in allusion to these properties, or their applications to useful purposes.

Asbestos, for example, the original term, comes from the adjective *asbestos*, *unextinguishable*, from a supposed practice among the Greeks, of using the mineral to form wicks for their perpetual or sepulchral lamps.

Amianthus, also bears, in its etymology, an indirect allusion to the effects of fire. The word *amiantos*, which signifies "incapable of being soiled," was given in consequence of the facility with which articles manufactured from this mineral were cleansed by means of fire.

Other names were bestowed upon it, which may be briefly noticed—the Romans called it *Linum Vivum*, both from its resemblance to flax and its indestructibility. It was also named *Linum Indum*, *L. Montanum*, *L. incombustibile*, *Lana Montana*, *Salamandra lapidea*, &c. The last name seems to have arisen from a conjecture that the fable of the salamander originated from a practice among the ancients of purifying by heat the various fabrications of this mineral.

Asbestos and amianthus, are the terms which have passed into the principal European languages.

We have the most positive records, that this substance was in use among the Greeks and Romans for the purpose of manufacturing articles in imitation of linen. The workmanship and quality, if we credit the testimony of Pliny and Plutarch, must have been of a very superior character.

The former writer ranks the amianth cloth next in quality to the byssus, or fine cotton, worn by wealthy ladies.—Plutarch also states, that this mineral was wrought into head ornaments for females. It does not appear, however, that the art of weaving it was sufficiently general to render the cloth cheap. Indeed, every circumstance seems to show, that this fabric must have been an article of luxury among the ancients; and there certainly was an obvious, though, perhaps, excusable parade of its incombustible properties upon all occasions. The practice in Pliny's time, and which he describes as an eye-witness, was to throw the napkins, of amianth into the fire, after a repast or banquet, in order that the grease and dirt might be burnt out. Each guest then delighted to behold his own napkin washed and rendered white and clean by display, or manifest preserve, is recorded of the first Philip, Charles V., during whose reign, amianthus manufactures seem to have been established at Venice; Ludovic, and other parts of Europe. Pliny adduces another very important use of this mineral cloth, namely, as a shroud or wrapper, for the bodies of kings, in order to preserve their ashes distinct from those of the funeral pile. That such a practice existed we have positive proof, independently of the historian's testimony, by the discovery, in 1702, near the Porta Nova at Rome, of a sepulchral urn, ornamented with elegant *bas-reliefs*, and containing a skull with some calcined bones—a quantity of ashes was also found enclosed within a cloth of amianthus, nine Roman palms long and seven wide. This relic was deposited in the Vatican Library, by order of Pope Clement XI. The very illustrative size agrees but badly with Pliny's account of its use, and will prevent caution us against confidence in his other exaggerated statements. It is said, that the disuse of burning the dead occasioned the decline of the manufacture of these cloths, until the art became entirely extinct in Europe. The correctness of this opinion will be noticed presently. Threads, nets, net-work, head-ornaments, napkins, table and funeral cloths, seem to have constituted nearly all the articles manufactured of amianthus in former times. Bonnets, gloves, purses, girdles, ribands, and even paper, have been subsequently made from it. The process by which the mineral fibre was anciently woven is not transmitted to us. In 1691, Ciampini, of Rome, published the following plan in his work, "de incombustibili lino;" and it may be considered nearly as precise as the nature of such manufacture will permit. Having steeped amianthus in warm water, divide its fibres, by gently rubbing them together between the fingers, so as to loosen and separate all the extraneous matter; then pour on, repeatedly, very hot water, as long as it continues to be in the least discoloured. After this, nothing will be left but the long fibres, which are to be carefully dried in the sun. The bundles are then to be carded by very fine instruments, and the long filaments thus obtained steeped in oil to render them more flexible. A small quantity of calcined rock, reduced

next to be mixed (taking care that the mineral fibre is in every part the principal material, and smoothly adjusted); by means of a spinning-wheel, the whole is to be drawn into a thread.—This cloth being woven, in the usual manner, is placed upon a clear charcoal fire, and made red hot, so as to burn out the vegetable or animal matter, &c. The remaining tissue will consist of pure white amianth. This kind of cloth has also been made, without the assistance of other substances, by rubbing and soaking the mineral fibres until they become so delicate and soft, as to admit of being spun at once into threads. This is the process recommended by Madam Perpeuti.

"The very short fibres which separate during the repeated washings, may be subsequently worked into paper. For this purpose, however, they require to be well-beaten, until reduced to an impalpable powder, and, subsequently, to be worked up with a large quantity of size in water. These precautions are far more necessary for the amianth than for cotton or linen paper, in consequence of the much greater weight of the mineral paste. After the paper has been formed, the sizing is burnt out.

"We will now briefly trace the decline of the mineral weaving, &c. It is apt to be the most glaring characteristic of the antiquarian virtuoso to lament the loss of certain arts among the moderns, nor does *utility* always constitute an item of his regrets. The ancient process for weaving amianth cloth appeared to be extolled, not from any accurate knowledge of the fact, but because a hint or two about its superior quality may be found among a few writers of antiquity. One of these authorities (Pliny), it is true, compares it with the byssine cloth, obtained from the neighbourhood of Elis, and which was very much esteemed; but while he thus intimates its superiority, he elsewhere bears indirect testimony that the cloth was used merely as a rare and curious article. This writer furnishes three strong reasons why amianth cloth could not have been in common use among the Romans. The first is, the difficulty of procuring the mineral. It is described as occurring on the deserts and parched grounds of India, where rain never falls, and where serpents and other formidable reptiles abound. Secondly, it is stated that the amianthus, when obtained, was very scarce, and commanded a price equal to that of the most costly pearls. Lastly, it is expressly noticed that the workmanship was exceedingly difficult, on account of the shortness of the fibre. These statements are not only in opposition to the belief that the ancients used such articles generally, but the last one goes far to contradict the assertion of Pliny himself respecting the quality. We have, however, a still stronger fact to show, that even in the rich and luxurious times of the Roman empire, the mineral cloth was not in much use for the purpose of collecting the ashes of the dead. Out of the immense number of ancient sepulchres opened in Italy during modern times, not more than one such cloth has ever been discovered, and that (found at Rome, 1702,) is of very coarse texture, and too small to answer the purpose of a wrapper for the body. In several urns charcoal was found mixed with the ashes, a circumstance indicating no great care.

"The truth is, that the cloth has always ranked as a curiosity, and, not unfrequently, has had bestowed upon it properties calculated for the credulous and ignorant. Pliny, who was ever too partial to hearsay records, has condescended to state, upon the authority of one Anaxilaus, that amianth cloth, merely wrapped round a tree, has the power of depriving the blow of a hatchet of all sound! The same relish for the marvellous, no doubt, induced Marco Polo to state, that the body of our Saviour was in his time, preserved at Rome in a shroud of amianth, or incorruptible cloth. Athanasius Kircher, (a Jesuit of the 17th century,) in his '*Mundus Subterraneus*,' also extols this mineral with all the zeal of a connoisseur. He boasts of having in his collection a paper-screen, and a lady's veil of it, together with a lamp-wick, which had burnt for two years without consuming, and which, he wisely adds, will last for ever, if not stolen. Whether this wick is still in operation, we have not learnt; but may venture to conclude, notwithstanding the testimony of partial advocates, that the decline of the art afterwards among the moderns is wholly owing to the insignificance of the articles manufactured.

"Experiment has abundantly proved, that although the amianth fibres are alone able to resist a red heat without much change, they soon (even in twenty-four hours) become incapable of transmitting a full supply of oil, owing to an imperfect cohesion effected by the flame. Hence it is impracticable to convert them into perpetual lamp-wicks. Neither is it true that a veil

heat has *no effect* upon them. Cloth, woven of amianth, actually does lose weight by burning; and, after repeating the operation several times, the fibres become so brittle, as to render it difficult to prevent them from crumbling to pieces. In two experiments made before the Royal Society of London, a cloth, one foot long by six inches wide, and weighing nearly 1¼ ounce, was found to lose, by the application of a red heat, more than one-twelfth of its weight each time. It would be considered a very bad piece of common linen that could be worn out out in twelve washings!—The only advantage which such cloth seems to possess over the ordinary kind, is the facility of cleansing it by fire; but, really soap is so cheap an article, that there could not be much gained in this respect by a change in fabrics. The amianth paper has even less to recommend it. It would be curious, no doubt, to return an answer upon the same piece of paper as that which was received from the post-office, merely by *burning out* the original; but it could not be agreeable to find our ink spreading at every letter, an inch wide, upon paper from which the fire had removed all sizing. So, also, it might appear highly important to possess an *incombustible* paper, upon which could be spread all important documents; but (not to mention the thousand methods of getting rid of the troublesome records without burning them) we must bear in mind, that an *unalterable* ink is as important as the paper, and none of those proposed has been found to be sufficient. *Incombustibility* alone must compensate for the article being heavy, coarse, weak, liable to blot, and not capable of taking the full impress of types. Books, it is true, *have* been printed upon this kind of paper, among which may be noticed the work preserved in the library of the Royal Institute of France; but, however highly authors may esteem their own productions, we feel fully persuaded that booksellers would not tolerate such nonsense from them now-a-days. To conclude, it may be observed, that, while it is not, by any means, our wish to interfere with the virtuoso's taste for neck-handkerchiefs and shirts of *stone cloth*, we must take the liberty of hinting, that, if the perfect art of weaving it *does not* now exist, there is not much lost."

SQUEEZING WAX.

Sir,—Being a subscriber of your very valuable Magazine, I should feel greatly obliged if some of your numerous correspondents would favour me with the receipt for making wax that is sometimes used by carvers and modellers for taking impressions of carved ornaments, &c. I believe its proper name is squeezing-wax, and the great difficulty is in making it tough and not stick. Hoping that some one of your many liberal-minded readers will favour me with particulars sufficient to enable me to make it.

I am, Sir,
With sincere respect,
W. Cookes.

Warwick, Nov. 18, 1829.

MISCELLANEOUS.

Poor-House Gardens.—"An excellent suggestion appeared lately in the *Gardener's Magazine* —that of having extensive gardens annexed (it is not meant locally) to parish poor-houses. It is very justly stated, that there is no description of labour in which all descriptions of persons, young and old, male and female, could so universally be of use, and that with the least inconvenience of all kinds of toils—the cultivation of a garden is the delight of labour. 'God Almighty,' says one of the wisest men that ever adorned humanity, 'first planted a garden;' and, indeed, it is the purest of human pleasures. It is, moreover, peculiarly favoured in this, that while it is the pleasantest of all descriptions of labour, it is for the gratification of simple events the most profitable also; and therefore the suggestion of the *Gardener's Magazine* is a hint which we think may be improved on with much advantage in the highest quarters, to which the consideration of a provision for our poor extends."—*Blackwood's Magazine.*

Erratum.—Sir, I perceive there is a mistake in the second line of my communication on the decay of stone cornices, &c. (vol. xii. p. 336) which I have no doubt you will be kind enough to notice in your list of errata. In the Magazine it reads, "It appears to me that the quick decay of the *corner* parts of mouldings;" but it ought to read, "It appears to me that the quick decay of the *upper* parts of mouldings."

Yours, &c. Pit.

INTERIM NOTICES.

S. Y. a young Engineer, is requested to send to our office for a letter addressed to him.

Communications received from Mr. Harrison—T. P.—S. P. B—e—S. P. W.—S. Y.—A Friend to the "Mechanics' Magazine"—William X.—I. W. (Member of the London Mechanics' Institution)—Thoms, Jun.—An Indigent Mechanic—Mr. Baddeley—A Glasgman—A Constant Reader—Gape.

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M. SALMON, Printer, Fleet Street.

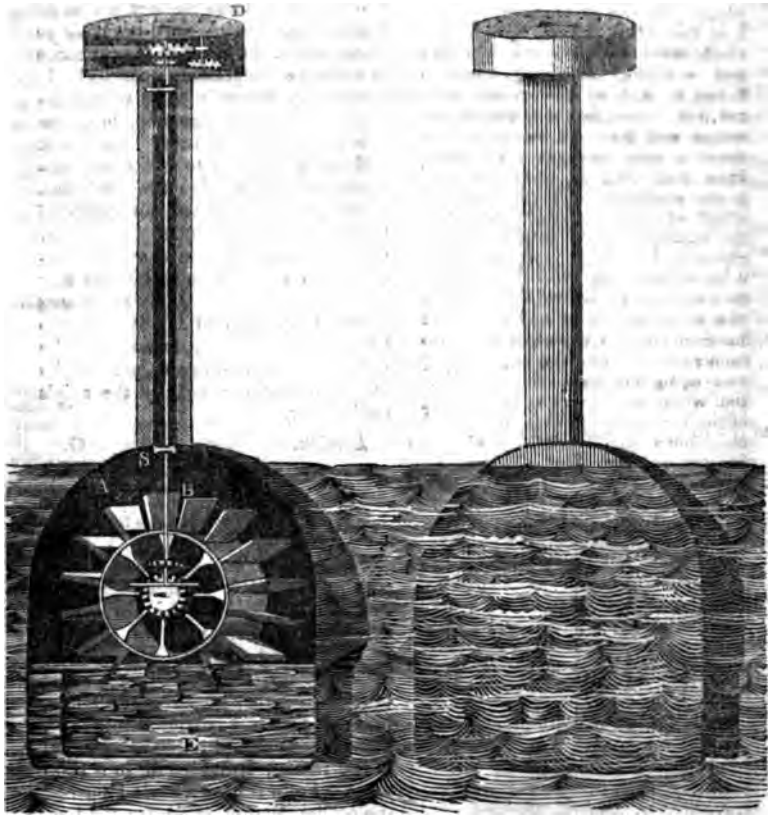
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 339.] SATURDAY, FEBRUARY 6, 1830. [Price 3*d*.

A WAY-METER FOR SHIPS.

Fig. 1. Fig. 2.



The prefixed draught is that of a projected machine to be affixed to the sides of vessels and submerged; and which, by indicating their rate, might supersede the use of the log, and may be called the way-meter.

This machine, it is proposed, should be made wholly of copper, and it is meant to be placed always so far beneath the water, as that it should never be left dry by the heaving of the vessel. Referring to fig. 1, in the draught, let A denote the container, within which the paddle-wheel is placed, and which should be rendered air-tight in order to prevent the water ever rising above the wheel. It is *obvious that the* water in the container (as in a diving-bell) would then only rise to a certain height; and that at no depth at which it would be either convenient or necessary to immerse the way-meter could the water rise higher in the container than it is represented to do in the draught. This being the case, it is apparent (and, moreover, decided by experiments) that the resistance opposed by the water to the paddles at the *lower side* of the wheel (the only part, for the reasons stated, that could be immerged) would cause it to revolve upon its axis as often as the ship passed through a space equal to thrice its diameter, or thereabouts. This motion being communicated by

the rod C to an index-finger on the dial-plate D (and which index might be made to circulate as slowly as should be deemed convenient for observation), the course of the ship may be easily and accurately measured, and, if required, even registered in the observer's absence: and as the most violent agitation of the sea would have but little, if any, effect on the water in the submerged container, there is no doubt the proposed machine will be found not only to answer the purpose much better than, but have many advantages over, the log.

S, fig. 1, refers to an air-collar, to prevent the air escaping, and within which the rod works. E indicates two wash-boards, which it is intended should be carried below the paddles of the wheel to hinder any side-swell from disturbing the wheel, or affecting it from that quarter; the two ends, of course, to be left open.

Fig. 2, shows the ship's way-meter as it will appear when closed up.

Fig. 3.

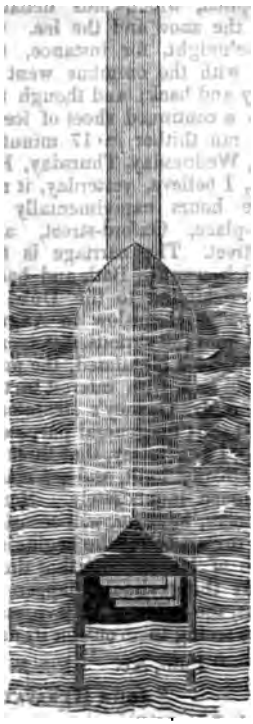


Fig. 3, exhibits the end of the way-meter, and which ought to be formed with a sharp or dagger point, as calculated to offer the least resistance to the ship's course.

It is not considered necessary to give any directions as to the *size* of the machine (which need not be *large* in any case), the effect of the machine in no respect depending upon its bulk, but in this regard is to be wholly regulated by that of the ship, to which it is meant to be affixed. Neither is it thought needful to make any observations on the subject of the bevel-wheels, as the slightest inspection of the draught must render that matter clear. There seems also as little occasion to attempt to point out any precise spot for fixing the way-meter; it will be enough to say it ought to be placed sufficiently forward on the vessel's side, in order to prevent its motion being checked by the ship's back-water.

London. G.

THE "PORTABLE TRIGONOMETRY."

Sir,—About twenty years ago I was in the habit of measuring the heights of trees for the purpose of ascertaining their rates of growth; and not being provided with a table of logarithms, I described on a sheet of foolscap paper a quarter of a circle, half of which I divided into 45°. The tangent of that angle being equal to the radius, I divided it into 1000 parts. From this as a scale I formed the accompanying table for the tangents for every other degree.

Had this table been correct, I should long ago have sent it to you, conceiving it to be constructed on a useful principle, which, until the appearance of your No. 320, I never saw recommended for practical purposes.

As your Edinburgh correspondent appears desirous of withdrawing as much as possible of the merit due to P. M. W. to attach it to Professor Leslie, allow me to step in to inquire whether the Professor has more right than myself to priority in the formation of such a table?

Perhaps it would not be right to

publish the table unless its errors are corrected (which may be done by the column of tangents at p. 81 in the number referred to); but I send it to you as it is, that you may see it as it was formed in the year 1810.

I have the honour to be, Sir,

A FRIEND TO THE "MECHANICS' MAGAZINE."

[Our correspondent then presents us with the manuscript copy of his table and rules, which exhibits every mark of being written twenty years ago. The table contains the natural *tangents* of every degree from 0° to 45°, and the natural *cotangents* of every degree from 45° to 90°. They are given to three places of decimals; and are usually, though not always, correct in the last figure. They serve, however, to show the accuracy of the construction from which our ingenious correspondent formed his table. The tangents in the first 45° he calls *multipliers*, that is, multipliers of a base or horizontal line, to obtain a vertical line; the cotangents in the remaining half of the quadrant he calls *divisors*, and employs for the same purpose. All this, as our readers will perceive, is quite consistent with the directions of P. M. W. in the "Portable Trigonometry;" but it is merely a single case of the utility to practical men of that able production.

Some time ago, we received a similar table from Mr. Foord; but it was not so correct as the one of which we are now speaking.

Another correspondent informs us, that by means of Professor Littrow's ingenious tables for finding the geocentric places of the planets,* and the table of natural sines and tangents in the "Portable Trigonometry," he has computed in much less than one page of letter-paper the right ascension and declination of Mercury for May 5, 1832, the *day on which there will be a transit of Mercury over the sun's disc, visible in Britain.* Our correspondent finds the right ascension of Mercury on that day to be 2h. 52m., the declination 16° 44′ N., which cannot be far from the truth. These taken together are no mean proofs of the utility of the "Portable Trigonometry."—ED. MEC. MAG.]

* Published in the "*Memoirs of the Astronomical Society of London,*" vol. iii. part 2.

MR. GURNEY'S STEAM-CARRIAGE.

(Extract of a letter from Mr. Herapath to the Editor of "The Times.")

"Previous to bringing the carriage 'generally out,' it has been the wish of Mr. Gurney to try it under every possible variety of circumstance, to leave not a shadow of doubt of its practical efficiency. Accordingly, all the opportunities which the severity of the season has afforded have been embraced with anxious sedulity. Sometimes it has been had out in the snow, at others on the ice, up hill and down hill, with a private carriage or an omnibus attached, and sometimes without, but uniformly with the same unqualified success. A very simple contrivance has suggested itself, and been applied, which bids defiance alike to the snow and the ice. On Friday se'nnight, for instance, the carriage with the omnibus went to Holloway and back; and though the road was a continued sheet of ice or snow, it ran thither in 17 minutes. Tuesday, Wednesday, Thursday, Friday, and, I believe, yesterday, it ran for some hours experimentally in Portland-place, Oxford-street, and Regent-street. The carriage is the same which went to Bath and back, and was exhibited to the Duke of Wellington at Hounslow in August last. As from the various statements which have been circulated, the public seems to look with interest to the time when Mr. Gurney's steam-carriages will start for general purposes; in passing, I beg to say, that three or four are already built, and are ready to commence immediately. Some circumstances, however, will occasion them not to start before the beginning or middle of March. At that time, unless any thing should happen to the parties, the public, I believe, may depend on seeing them out for its use.

"I am, &c.

"JOHN HERAPATH.

"Cranford, Jan. 31."

ON THE VELOCITY ATTAINABLE ON RAILWAYS.

Sir,—I have been much amused, and I may add instructed, by the ingenuity displayed in the series of papers which have appeared at different times in your pages, during the discussion of the celebrated railway question; I allude particularly to that branch of it which arose respecting the doctrine laid down in *The Scotsman*, relative to the velocities attainable by carriages, and the power required for that purpose. Not possessing the early parts of the "Mechanics' Magazine," I have not read the beginning of this discussion; but from what passed subsequently, I gather that it was meant to be demonstrated, that with the same expenditure of power per second, a carriage might be moved along a railway with any velocity whatever; and the method of proof was, if I recollect right, by supposing a weight (more than sufficient to overcome the friction) to be attached to the vehicle, by means of a rope passing over a pulley at the end of the plane or railway.

Then, since friction is opposed to the descent of the weight by the action of gravity, the difference between this weight and friction will be the motive force at the commencement of motion; but because gravity produces a given acceleration or increase of velocity at the end of each unit of time, and friction causes a given retardation or decrease of velocity at the end of the same units of time (this having been proved by the experiments of Coulomb and Vince): therefore the acceleration arising from the excess of gravity over the friction, must also be a constant quantity, and equal in equal times; and of course a carriage so moved, obeys the laws of uniform acceleration. And hence, because the motive force is constant, it was inferred, that with the same expenditure of power per second, any velocity whatever might be attained.

As far as the proof goes, (i. e.) in cases where gravity is the prime mover, there can be no doubt of the correctness of the above assertion; but may not a doubt arise, whether the *question* in the above case applies to *that* which they have demonstrated; and may we not reasonably ask, whether there is any mechanical power or agent within the reach of human ingenuity that acts in a manner similar to gravity, (i. e.) producing equal accelerations in equal times: for this is the test to which they have subjected themselves, by assuming a weight acting by the force of gravity as their motive power, in lieu of some machine? The question, then, I imagine, will be this—Does the acceleration arising from a succession of impulses by one given body in motion upon another in motion, when the velocity of the impelling body (and consequently its force) is constant, increase equally in equal times?

Let us take the case of two bodies whose weights are A and B, and velocities a and b, moving in the same direction on the line passing through their centres of gravity, and in an unresisting medium. We will suppose them imperfectly elastic — that the force of compression is to the force of elasticity, as 1 : m, and that A is the impelling body.

By Wood's Mechanics, pr. 47, the velocity gained by B in the direction of A.'s motion, after the collision or impact, will be represented by $\frac{(1+m)\,A}{A+B} \times (a-b)$; and the velocity lost by A, in the same direction, is $\frac{(1+m)\,B}{A+B}\ \overline{(a-b)}$: then $b+\frac{(1+m)\,A}{A+B} \times (a-b)$ will be B.'s actual velocity after the first impact $= \frac{Aa+Bb+Am\times(a-b)}{A+B}$

Now, suppose that some time after the first impact, A.'s velocity and energy should be renewed as at first assumed, and again overtake B moving with its acquired velocity, then, by substitution in the original equation or expression, we shall have $\frac{(1+m)\,A}{A+B} \times (a-\frac{Aa+Bb+Am\,(a-b)}{A+B}$ for the velocity gained by B after the second impulse $= \frac{(1+m)\,A}{A+B} \times \frac{Ba-Bb-Am\,(a-b)}{A+B} = \frac{(1+m)\,A}{A+B}$.

$\times (a-b) \times \left(\frac{B-Am}{A+B}\right)$ which is a general expression for the effects of a succession of impulses upon another body moving by virtue of them: for the velocity gained after the second impact is equal to its preceding increment, multiplied by $\frac{B-Am}{A+B}$; and if we assume B.'s velocity just before the second impact as a *first* velocity, then will the velocity gained after the then succeeding impulse $= \frac{(1+m)A}{A+B}$ $(a-b) \times \left(\frac{B-Am}{A+B}\right)^2$; and the same may be proved by continual substitutions in our original expression. Thus, then, it appears that the increments of velocity gained by B will form a geometrical progression, whose first term is $\frac{(1+m)A}{A+B}(a-b)$, and ratio $\frac{B-Am}{A+B}$; and since the denominator of this last fraction is greater than its numerator, the series will decrease *ad infinitum*.

Cor. 1.—If $m=o$, or the bodies, are perfectly hard and inelastic, the expression for the n^{th} term is $\frac{A(a-b)}{A+B} \times \left(\frac{B}{A+B}\right)^{n-1}$

Cor. 2.—If they are perfectly elastic, or $m=1$, then it becomes $=\frac{2A}{A+B}$ $(a-b) \times \left(\frac{B-A}{A+B}\right)^{n-1}$

In a similar way, when A and B move in opposite directions (in which case the relative velocity is $(a+b)$, the velocity lost by A after the n^{th} impact $= \frac{(1+m)A}{A+B}\left(a-b\frac{A-Bm}{A+B}\right)^{n-1}$

In general, therefore, the increments will be expressed by a series, such as the following: a, ar, ar^2, ar^3, where r is a fractional quantity: hence, to determine the greatest possible velocity which B can attain after an infinite number of impulses, we must sum the series, which is $=$

$$\frac{a}{1-r} = \frac{(1+m)A(a-b)}{A+B} \Big/ \left(1-\frac{B-Am}{A+B}\right) = \frac{(1+m)A}{(1+m)A} \times (a-b) = a-b$$

$\because b+(a-b)=a$ is the ultimate velocity attainable by B; that is, just equal to that A.

It has hitherto been assumed, that each impulse happened after some interval of time, and in the mean time, that the body B moved uniformly with its acquired velocity; but as we are at liberty to assume those times or intervals as short as we please, suppose them to be exceedingly small or evanescent, and then we have the effect of continued uniform pressure, acting mechanically upon another body in motion; and these effects must be in accordance with the above law. Indeed, Dr. Wood says—"The effects of pressure and impact are manifestly of the same kind, and produced in the same way. Excess of pressure on the one side produces momentum, and equal and opposite momenta *support each other* by opposite pressure. Thus also pressures may be compared either by the weights they would sustain, or the moments they would generate, under the same circumstances." P. 30.

In estimating the effects of pressure as above, the intervals of time being evanescent, we cannot appreciate the successive increments of velocity; but by adding together any given number of the terms of the series we obtain (as is well known) another geometrical progression, in which the increments for any given space of time, as one second, can be successively measured: thus, $a+ar$, $a+ar \times r^2$, $a+ar \times r^4$, &c., which is the original series under a new form—a geometrical progression, having a different first term and ratio.

The result of all this is, that if a body be impelled (or drawn, for the effect is manifestly the same) by

another in an unresisting medium, let the latter be ever so small, the former will ultimately attain the velocity of that by which it is moved, and no more. The only difference in applying large and small bodies moving at the same rate, as a motive force, being this, that the larger they are, the quicker will the series converge, and the sooner will B attain the same speed as A, as a reference to the series will show. If, therefore, we wish to obtain mechanically a double velocity in B, we must also give A a double velocity; but then double power is expended contrary to what has been asserted in *The Scotsman*. At the same time it will be remarked that we can, if we make use of different bodies as our prime mover or mechanical agent, obtain ultimately even a greater velocity in the body moved, at the same or less expense of power per second; for if A be decreased, and a increased in the same or a greater proportion, the different values of Aa, which represent the force or momentum of A, may be either equal to, greater, or less than its former value; but a necessarily increases, and therefore the velocity communicated will be increased accordingly: but this is not (generally speaking) the sense in which the comparative expenditure of power is meant to be taken—it is to be confined to the same body, whatever it may be. The last observation will, I think, be found (subject to the effects of friction and the resistance of air, &c.) to be in accordance with the fact. The wind may act with the same force as water, but the former necessarily moves faster than the latter, and will, *cæteris paribus*, produce a greater velocity than the latter.

It appears to me that the very worst of all methods that could have been devised for settling the question, is that of calling in aid the effects of gravity. I think I have shown that the mechanical accelerating force is a continually decreasing quantity; on the other hand, the acceleration of gravity is uniform and constant. On this ground alone it appears to me, the latter cannot lead to correct results.

I think, moreover, that in some instances the cause of its being made use of is the misapprehension of the term "moving force," as applicable to constantly accelerating forces, which are only known to us by the effects produced; and, therefore, can only be compared by such effects under similar circumstances. Hence Wood's "Mechanics"—"The accelerating force is measured by the velocity uniformly generated in equal times; no regard being had to the quantity of matter moved." And "the moving force" is measured by the momentum uniformly generated in a given time, or M and BV, where M moving force, B mass, and V, equals the velocity uniformly generated in a given time, *i. e.* the accelerating force. Now, these measures are merely comparative; they indicate the intensities of any two or more given forces, which are to be compared by their effects; but they do not inform us of the nature, power, or energy of such uniform forces themselves. On the other hand, the general acceptation of moving force, as applied to machines, &c., is the momentum, *i. e.* the product of the moving body into its velocity.

It will be observed, that by supposing A.'s velocity to be continually resumed after impact or pressure (A losing as much momentum as B gains), nothing more is meant than that its energy or force against B remains unchanged and invariable; although of necessity A can move with no more velocity than B, yet the force or momentum of A should not be measured by the product of its mass and actual velocity, but such a velocity as it would move with, supposing the opposing body instantaneously withdrawn. The tension of the string, on the supposition that B is drawn by A, must vary according to the difference between the velocity with which A would move and that with which it does move, that is, as $a-b$; but by our preceding series it will be seen, that the differences of velocity between A and B are in geometrical progression, as well as the increments; for the part $(a-b)\times\left(\frac{B-Am}{A+B}\right)^{n-1}$ in, this difference after the n^{th} impart. The tension, therefore, varies

in this proportion, and ultimately becomes $=o$, when the two bodies move at the same rate.

If the effects of friction be traced, even the foregoing velocity cannot be quite attained; and the limit will be continually narrowing as the friction is greater.

Yours, &c. R. C. Jun.

FLAX VERSUS COTTON.

Sir,—I would inquire through the medium of your useful Magazine, why the use of linen thread, especially in sewing, has of late years given place to cotton; an article so much inferior in strength and durability, which, however, the manufacturers have brought to very great perfection, but of which I know not why flax should not be equally susceptible. Does cotton possess any peculiar quality to render it more generally useful than flax, or is it that the raw material is obtained at less expense?

The bad quality of much of the paper of the present day, owing apparently to the use of cotton instead of linen rags, chiefly suggested this inquiry.

I am, yours, &c.

Dec. 9, 1829. E. W. G.

CYLINDRICAL RAILWAY-CARRIAGE.

The following account of a very novel and ingenious description of railway-carriage, invented by a Mr. P. Fleming, engineer, of New York, is given by Dr. Jones, the Superintendent of the Patent-office at Washington, in a recent Number of the "Journal of the Franklin Institute."

"The carriage is a cylindrical body, which may have an axis passing through it, or gudgeons affixed to, and projecting from, its ends, for the purpose of drawing it. The wheels are iron rims placed round the cylinder so as to encompass it like hoops; these stand at a proper distance from each other, to run upon the rail; they are provided with flanches, or have their faces finished in any form suitable to the rail upon which they are to run. In the inside of the cylinder may be stowed boxes, barrels, bales, or *other goods to* be transported. When bars of iron, lumber, or other articles of considerable length have to be carried, the traction is performed in a different way; the carriage is then a hollow cylinder, not furnished with ends; the iron bars, boards, or plank, are passed entirely through it, and, of course, do not admit the employment of an axle, or gudgeons. In this case an endless rope is passed round the middle of the cylinder, which is furnished with double rows of pegs to form a groove, or checks, to retain the rope, or band, in its proper place. This rope also passes over a pulley, which is attached to the horse, or other drawing power, so as to work like the large and small wheels of a lathe with their bands. Two, three, or more cylindrical carriages may be made to follow each other, when connected by bands in the same way.

"Under this arrangement it is evident that whatever is carried must roll with the carriage, but in transporting some kinds of goods, and particularly in carrying *persons*, this would, to say the least of it, be very *inconvenient*. To obviate this objection, a second cylindrical body is placed inside of the first, and is made sufficiently small to revolve within it. This is suspended upon the axis, or gudgeons, and is weighted on one side, so that whilst the outer cylinder rolls upon the road, the inner one will not revolve with it. It is proposed sometimes to make this suspension by the agency of friction-wheels, so as to leave but little more friction than that which results from the rolling of the carriage. The patentee says—

"'What I claim is the use of a cylinder, or other volume of revolution, on a railway, as a carriage, or vehicle for transportation.

"'I also claim as my invention the use of the endless rope in the manner above described, for progressive motion. By means of this use of the cylinder and traction-rope, friction is saved, or avoided, to a greater degree than by any machine now known. The traction-rope may be employed separately from the cylindrical railway-carriage, in any other machine where similar progressive motion is required.'"

DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. VII.—PILE-DRIVING.

(Continued from p. 386.)

Fig. 5

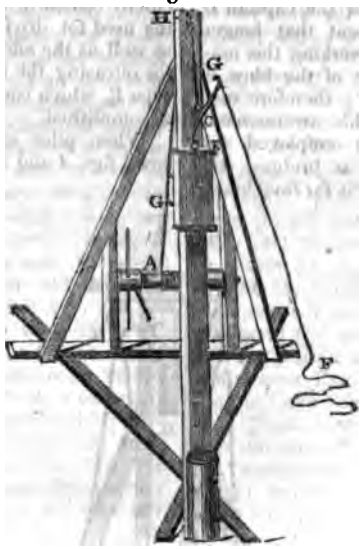
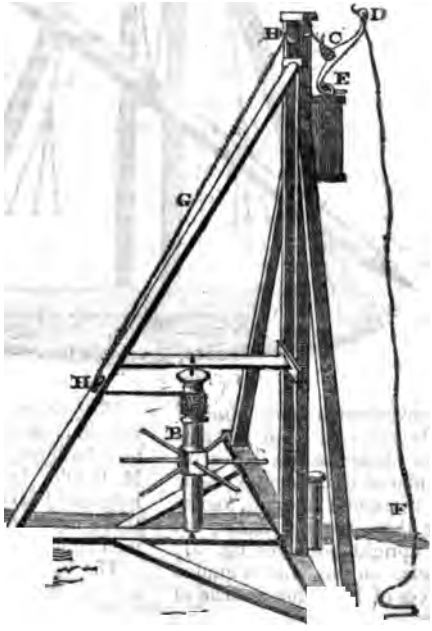


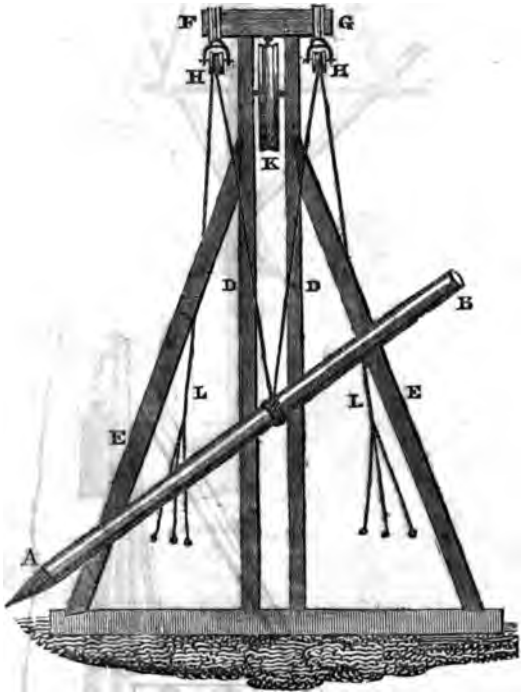
Fig. 6.



Figs. 5 and 6 are farther improvements on the ordinary machine, and are intended for raising a weight or ram of 12 or 1500lbs. by the action of three or four men applied to the windlass A (fig. 5), or the capstan B (fig. 6). It is evident that longer time is required for working this machine, but the force of the blow is considerably greater; therefore machines combining this arrangement are more generally employed for heavy works, such as bridges, &c. The power, however, is far from being applied in a vertical direction, and time is also lost in releasing the hook C from the weight E, as well as in replacing it after the ram has descended. The advantages of fig. 5 chiefly consist in its capability of being used for driving piles in corners, as well as the addition of the hook C for releasing the ram by pulling the rope F, which could not otherwise be accomplished.

When piles are to be driven in rows, figs. 4 and 7

Fig. 7.



are more convenient, as they admit of being easily removed from place to place. The shears in this latter instance are placed in the centre of one side of the triangular framing, and in the former there are no shears, but simply an upright post (see fig. 5); the ram slides on this, and is guided by two pieces of bent iron instead of the grooves.

Piles driven in horizontal positions are either driven by an engine similar to a battering-ram, or (according to M. Belidor) by slinging ropes round a long and heavy piece of timber, and throwing it forward by six or eight men against the head of the pile.

The lucid remarks of Mr. Nicholson on the power of pile-machines, constructed in a similar manner to

these, merit a notice in this place. 1st. The momentum of the stroke will be as the square root of the height from which the rammer fell. He says, that "notwithstanding the momentum or force of a body in motion is as the weight multiplied by the velocity, or simply as its velocity when the weight is given, or constant; yet the effect of the blow will be nearly as the square of that velocity, the effect being the quantity the pile is driven into the ground by the stroke. For the force of the blow transferred to the pile, being destroyed in some certain definite time by the friction of the part within the earth, which is nearly a constant quantity, and the spaces in constant forces being as the squares of the velocities, therefore the effects, which are those spaces sunk, are nearly as the squares of the velocities, or, which is the same thing, nearly as the height fallen by the ram to the head of the pile."

The term *en fiché* having been used, the figs. 7 and 7* will explain the matter clearer as to what is meant by putting a pile *en fiché*.

Fig. 7*.

Let fig. 7 represent a part of the pile-engine framing, constructed with the wheel four or five feet diameter, as mentioned in paper No. VI; the cap FG projects a short distance beyond the upright posts DD; to this cap pulleys HH are fixed, the pile is suspended by ropes, and afterwards lowered to the workman, who places it in its proper position (see fig. 7*) to receive the blow. It is there held for a short time in a perpendicular direction until it is partially fixed, when the driving of it is completed.*

Another practice adopted in pileing is to lower a strong grating of timber, and between the openings or chequer-work of the framing the piles are inserted and driven. Border-pileing is also driven round the exterior of this grating. A very essential precaution

* The same references apply also to paper No. VI.

is necessary in commencing the pileing in this instance; that is, by driving the first piles in the centre of the framing, and proceeding with the work outwards to prevent the earth being jammed in the centre, which would be the case were the pileing to commence at the edge of the framing.

In coffer-dams the larger piles face the water, and the double or triple rows are of smaller scantling. In some situations the grating of timber, covered with thick planks, and the pier carried up upon that has been found to be sufficient without pileing. Plank or other pileing driven obliquely into the earth, is only bevelled on one side of the lower end; and such piles, if of small scantling, are charred on their extremities instead of being shod with iron. The thickness of short piles is allowed to be 1-12th of its length; but for long piles the average diameter is from 14 to 16 inches. Plank piles are in thickness from 3 to 4 inches, and from 4 to 6 according to their lengths.

(To be continued.)

SIMPLE METHOD OF FINDING A MEAN PROPORTIONAL BETWEEN THE TWO SIDES OF A RECTANGLE.

Our old and esteemed correspondent, O. C. F, informs us, that the mean proportional, AE, between the length and breadth AB, AC, of a rectangle, as employed in fig. 1, of Mr. Hughes's solution (p. 411 of our last Number), may be found more easily than by the usual process, when AC is either equal to or greater than $\frac{1}{2}$ AB.

Thus, on AC set off AK$=\frac{1}{2}$ AB (the letter may be easily supplied, and the additional line drawn in the figure referred to): with K as a centre and KA as a radius, describe an arc to cut CD in E: join AE, which is the mean proportional required.

For, drawing the right line KE, we have $CE^2=KE^2-KC^2=(\frac{1}{2}AB)^2-(AC-\frac{1}{2}AB)^2=AB\cdot AC-AC^2$ and $AE^2=AC^2+CE^2=AC^2+AB\cdot AC-AC^2=AB\cdot AC$ $\therefore AE=\sqrt{AB\cdot AC}$, a mean proportional between AB and AC.

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

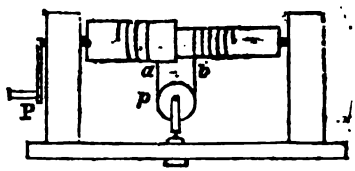
(Continued from p. 409.)

It is frequently required to estimate the amount of the pressure on the pivots, which is thus done:—Find the centre of gravity of the wheel and axle, and the weight of the machine will be divided between the pivots in the *inverse* proportion of their distances from the centre of gravity.

There are two ways of increasing the mechanical advantage of the wheel and axle; viz. first by *increasing* the radius of the *wheel* on which the *power* acts; and, secondly, by *decreasing* that of the *axle* on which the *weight* acts. In theory there appears to be no limits to either of these means, but in practice there are. In the first manner, the limit is the unwieldiness of the wheel; and with regard to the second, it may be asked, what are the cases where the mechanical advantage is desired to be increased? The combination is for raising a *heavy* weight; and on what part of the machine will this weight press, but on its axis? The axis, therefore, ought to be increased as much as possible, since by diminishing the axis the strength is reduced.

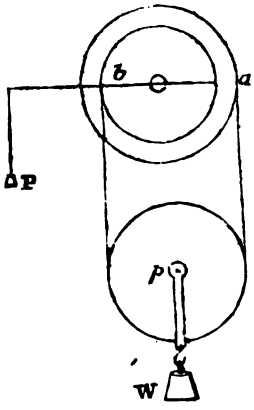
There is a very ingenious method of increasing the strength of a machine of this kind, without either of the above disadvantages. Fig. 1 is

Fig. 1



a front view, and fig. 2 a section of this combination (the same letters referring to the same parts in each). It will be seen that a rope after being coiled round one part of the axis, and turned round the pulley *p*, is coiled in the *opposite* direction round the other part. Now, as the weight is supported by the two parts *ap* and *bp* of the rope, the tension of each part is equal to one-half of the weight; consequently the difference

Fig. 2

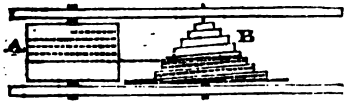


of the products of the half weights, multiplied by the separate radii of the two axes, will give the effective force; or, what is the same thing, the force is equal to the half weight multiplied by the difference of the two radii.

A varying lever is frequently useful in machines where the work to be done, or the load to be raised (whatever be the resistance), is not uniform, while the power is so.

This is done by using a leverage, which shall increase in power in the same proportion as the weight does: of which kind, one of the most beautiful instances is the fusee of a watch.

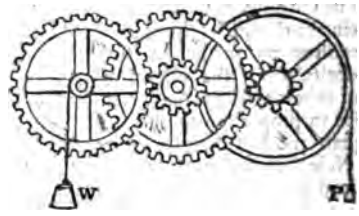
Fig. 3.



The spring (which is the prime mover of the watch) is a spiral piece of steel; one end of which is fastened to the fixed axis of the barrel A, and the other to the barrel itself (the spring being enclosed in the barrel). When the spring is wound up, its power is at its height; and as the watch goes down (to use a common phrase), the spring loses its elasticity, and exercises a constantly diminishing force on the fusee B, round which the chain is coiled. This fusee is of a conical *figure*, and the chain is fastened to *the larger* part of it at one end, while the other is fixed to the barrel. Now when the watch is wound up, the chain is wound on the fusee, so that when the spring is at its highest intensity, the leverage it acts at is at the smallest; and in proportion as the power (viz. strength of the spring) *decreases*, the leverage increases. If the elasticity be called E, and the radius R, E R will always express the whole effect.

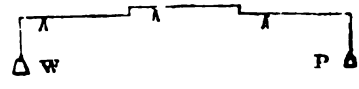
There is another way of increasing the power of the wheel and axle, without either of the disadvantages before mentioned: it is by means of what is called wheelwork—one wheel acting on another; and the series of wheels being connected either by straps, by friction, or by teeth. The first is a very common method, and is used in turning lathes and many other machines; the second is very uncommon, indeed hardly ever used. Wheels acting on one another by the third method, have a similar toothed-wheel fixed on the axle, which is called a *pinion*. The teeth of the large wheels are called cogs, but those of the pinion are called leaves. The cogs of one wheel act on the leaves of a pinion, on the axle of which is placed another wheel, whose teeth act in the same manner. Fig. 4 represents three wheels acting in this way. It

Fig. 4.



will be evident that this is nothing but the compound lever in another form; for if the upper and lower halves of the wheels be cut off, it will leave the system of levers as in fig. 5,

Fig. 5.



the effect of which is easily calculated; viz. the power is to the weight

as the continued product of the arms of the levers presented *towards* the *weight* is to that of those turned *from* the *weight* or *towards* the *power*. But although this may be one way, yet it is not the practical method. The number of teeth in the wheels and the leaves in the pinions are found; and then the power is to the weight, as the continued product of all the leaves is to that of all the teeth.

(To be continued.)

VELOCITY OF WATER IN PIPES.

Sir,—It seems from the communication of your correspondent Aqueduct, that I mistook his meaning in respect to the pipe having a *slope*—this, however, makes no material difference in the result obtained. This your correspondent seems to admit, as he observes, that "he cannot think it would matter much whether the insertion were into the bottom of the reservoir or not!" Otherwise, who would suppose him to be so ignorant as to think that the water in the reservoir being *below* the horizontal level of the pipe, can have any effect on the velocity of the water passing through it? *Every body knows* that the velocity of the water in the pipe depends on the altitude of the head of water *above* it, which generates its initial velocity; the greatest velocity being at its entrance into the pipe—the pipe being horizontal—the water evidently acquires no further increase in its velocity from the effects of gravity, but is retarded by the friction of the pipe in proportion to the ratio of the square roots of their lengths nearly.

Now, according to the result obtained from the formula of Du Buat, we find that the retardation occasioned by the friction of the pipe is very nearly equal to the initial velocity. If we suppose the pipe to be plugged up at the extremity, and a small hole to be made in the top of the pipe near the reservoir—it is well-known both from theory and practice, that the water will spout nearly to the height of the head of water in the reservoir. But this will not be the case in a pipe of 200 miles in length, when a small hole is made in the pipe at this distance from the reservoir. The water will acquire the same level, it is true; i. e. suppose the pipe at the end to be turned up in a vertical position, the water will rise in it to the same level as that in the reservoir at 200 miles distance; but it will be a considerable time in acquiring that level. The height to which the water would spout would in each respective case be equal to the $\frac{1}{133}$, $\frac{1}{196}$, $\frac{1}{156}$, and $\frac{1}{133}$ part of an inch only. Now, if we suppose the pipe plugged, and a hole drilled $\frac{1}{10}$ part of an inch in diameter, and the same quantity of water to pass through the adjutage, as that which passes through the pipe, according to Du Buat's formula, the water will in this case issue with a velocity equal to that in the pipe $\times \frac{\text{area pipe}}{\text{area adjutage}}$ or in each case equal to 133, 196, 156, and 35 inches per second. And the height to which the water would spout would be nearly equal to 23, 50, 32, and 1·6 inches respectively, neglecting the resistance of the air and aperture of the adjutage.

In respect to the *quantity* of the discharge, I did not, as your correspondent supposes, mistake the *drift* of the inquiry. And in respect to my taking the discharging orifice at $\frac{1}{4}$ an inch in diameter—I took it as stated in the inquiry; no mention being there made as to the pipe being plugged up at the end, or an aperture being made in the side of the pipe, the answer was therefore quite as consistent as the *question* in which the *marrow and substance, mind you,* was wanted! As to Du Buat's formula, I am quite aware that it is *empirical;* but in its application to the present inquiry, it will admit of its greatest accuracy, the results in pipes of considerable lengths being nearly the same as those which are found to obtain in practice. It is principally in pipes of short lengths in which this formula fails, where the slopes are very considerable. Suppose, for instance, the length of the pipe is 50 feet, and the height of the upper above that of the lower end of the pipe = 30 feet. Now it is evident that the pipe is the hypothenuse and

the altitude of the upper end, the perpendicular of a right-angled triangle; therefore the value of *s*, or slope of the pipe, is equal to $\frac{1}{8}$ *nearly*: hence whatever may be the *length* of the pipe, the value of *s* in this formula will *always* be the same. Here then this formula fails of giving a correct result, and other formulas are therefore substituted in similar cases; but I know of no formula which is allowed to give a more correct result than that of Du Buat in the present inquiry. If your correspondent can point out one, that one will be the *marrow and substance, mind you*, and will determine the *drift* of the inquiry at once.

I am, Sir,
Yours, &c.
J. UTTING.

Lynn Regis, Feb. 2, 1830.

MR. GILMAN.

Mr. Editor,—Secure in the ultimate result, I am quite content to draw upon my stock of patience, and permit the Practical Engineer—the *spirited vizor-covered* champion of Legion and exposer of *im*position—to run at the end of his tether until my leisure permits me to attempt to break a lance with him: knowing full well, that in the mean time there is no fear *his* practical knowledge will *im*pose upon any one. It matters little whether the Practical Engineer knows me or not; my observations are not the less applicable to him on that account. In my last letter to the Magazine, I purposely touched on the subject of the joints and bolts, knowing by the tenor of his first letter that it would produce an amusing display of his abilities; and hence we see that because *he* cannot *comprehend* how such joints can be made, he assumes, as a necessary consequence, that my narrative must be altogether an *im*position; and is induced to break out into the exclamation of "Mr. Gilman, Mr. Gilman, how can you have the effrontery to make such assertions!" Mr. Gilman begs to assure the Practical Engineer that he is perfectly easy about *the matter*, and has nothing to fear, notwithstanding the Practical Engineer's confidence; and that there really are more things in heaven and earth than the Practical Engineer appears to have yet dreamed of in his philosophy. Verily this Practical Engineer seems quite as much puzzled about these joints, as Peter Pindar represents the King to have been, when he attempted to discover how the joints of apple-dumplings were made.

Yours, &c.
WM. GILMAN.

FARTHER PARTICULARS OF PROFESSOR ALDINI'S INCOMBUSTIBLE DRESS FOR FIREMEN.

The following additional particulars respecting Professor Aldini's incombustible dress for firemen, of which we gave a brief notice in our last Number, are chiefly derived from a Report of a Commission recently appointed by the Royal Academy of Paris to investigate the merits of the invention. The Reporter to the Commission was M. Gay Lussac:—

The dress of M. Aldini consists of two garments;—one a thick tissue of amianthus, or of wool rendered incombustible by being steeped in a saline solution; the other, an iron wire-gauze dress covering the former. The idea of the latter was suggested to him by the chain-armour of the ancients, which he found to be impervious to flame; upon the principle first discovered by Sir H. Davy, and employed by him in the construction of his safety-lamp. This wire-gauze dress, however, would not alone be sufficient to protect the body from the action of heat, though it might ward off the flames: but the dress of amianthus, or wool, by its thickness and non-conducting power accomplishes this, and forms with the wire-gauze an efficient defence, for the time at least that the exertions of the firemen require.

The head-piece consists of a stout cap of amianthus-cloth, fitting close to the skull, and covering the throat, having holes made in it for the nose and mouth: spectacles are also provided for the eyes, lined with fine brass wire-gauze.

The metallic dress consists of five different pieces: the helmet, between which and the amianthus cap there is a considerable space, and which is moreover furnished with a mask in front, to afford additional security to the face; a cuirass, arm and thigh pieces, the

latter joining the cuirass over the hips; a pair of boots; and a shield of an oval form, five feet and a half long, and two and a half wide. This shield is useful in stopping or turning any strong jet of flame, and thus enabling the fireman to see his way; and it is proposed to construct frames on a similar principle, to intercept the flames issuing through a door or other aperture.

The whole of this dress is composed of iron wire-gauze, the meshes of which are about one twenty-fifth of an inch in diameter: the weight of it altogether is about 15lbs. The fireman has likewise a basket, covered with wire-gauze, strapped to his back, for the purpose of transporting a child through the flames; ropes and double gloves also of amianthus have been made, with the latter of which, red-hot bars of iron may with safety be carried in the hand.

A fireman, with the double protection of the incombustible cloth and wire-gauze, subjected his face to the flame of a straw fire held in a chafing-dish, for the space of 1 minute and 30 seconds. Another, armed as the former, with the addition of a sheet of amianthus in front, supported the heat during 2 minutes and 37 seconds without any symptoms of suffering. The pulse of the first rose during the experiment, in the space of a minute, from 80° to 120°, and that of the second from 72° to 100°.

The next experiment was still more satisfactory. Two parallel hedges, about three feet distant from each other, were formed of straw and brushwood, piled upon bars of iron. When these were set on fire, the flames from the two rose in a body to the height of at least nine feet, and filled the entire space between; while the heat was too great to approach nearer than eight or ten paces. At this instant, six firemen, accoutred with the dress of M. Aldini, and following each other at a slow pace, traversed the flames between the hedges many times in succession. One of them carried an osier-basket covered with wire-gauze, containing a child eight years old, protected only with a mask of incombustible cloth. This experiment, which the bystanders witnessed with apprehension, had a most satisfactory result; and had the smoke been more dense, it would have been entirely decisive. The firemen were unhurt; the one with the child retreated from the fire in the space of a minute, on account of the cries of the child, who was frightened at a sudden movement of the man in shifting it on his shoulder. The child was also uninjured, and when taken from the basket its pulse had risen only from 84° to 98°. The other firemen sustained the experiment 2 minutes and 22 seconds; and on coming out, were in a profuse perspiration.

The pulse of the fireman who carried the child rose from.....	92° to 116°
That of the second.....	88° to 152°
That of the third	84° to 138°
That of the fourth.....	78° to 124°

The main question was, the possibility of supporting respiration in the midst of the flames: and if we suppose the men to be completely enveloped in them for two three minutes, their situation certainly appears most perilous. M. Gay Lussac observes, that when a furnace is heated so as to flame and smoke, the air within is entirely deprived of oxygen; and therefore it is certain, that if the immediate action of the flames were guarded off by the wire-gauze, still it would be impossible to sustain respiration in the midst of them. We must therefore conclude that if the firemen did not experience the difficulty of breathing which we should naturally expect, they must have been supplied in some way with pure air. There are several ways of accounting for this; and one, which M. Gay Lussac suggests, appears the most probable; viz. that the men were supplied by a current of fresh air from the space between the two garments. Besides this, we cannot suppose that their heads were constantly enveloped in the flames, and they would of course find favourable moments for breathing; but the power of suspending the breath is also an excellent resource, which every fireman ought by practice to acquire. The fireman has another difficulty to contend with, in the dense volumes of smoke, which prevent his breathing, blind his sight, and consequently retard his exertions. To obviate this, it has been proposed to furnish a supply of air from a portable reservoir; or by means of a flexible tube, rising from the feet to the mouth, through which the fresh air would naturally rise, as the heated air escaped above.

There is little doubt that amianthus may easily be manufactured: M. Aldini has succeeded in weaving a [illegible]

of it, 9 feet 5 inches long, and 5 feet 3 inches wide, being nearly equal to the celebrated one preserved in the Vatican. But the cost of this material cannot admit of very general use; and on this account M. Aldini is endeavouring to substitute for it a manufacture of wool.

Wool is naturally but little inflammable, and when steeped in a solution of sal-ammoniac and borax, or alum, burns to a cinder without inflaming; it is also slowly penetrated by heat. It appears from an experiment of M. Flourens even to have an advantage over amianthus. That gentleman presented a finger covered with amianthus cloth to the flame of a wax-candle, and afterwards repeated the experiment, substituting a covering of the prepared wool of the same thickness. In the first case he experienced the effect of the heat sooner than in the latter. In point of economy, facility of preparation, and convenience, from its greater lightness and weaker conducting power, the preparation of wool has the preference over amianthus; and though its resistance to fire is less than the latter, it is still sufficient in all ordinary cases, and may form a very sufficient substitute.

FURTHER EXPERIMENTS WITH "THE NOVELTY" STEAM-CARRIAGE ON THE LIVERPOOL AND MANCHESTER RAILWAY.

Extract of a Letter from a Correspondent.

Liverpool, Jan. 28, 1830.

* * * *

"On Tuesday, the 26th, a series of very interesting experiments were made with "The Novelty" on the two miles level at Rainhill, under the direction of Mr. Vignoles, the engineer; which had chiefly for their object, to ascertain the weight which this engine is capable of drawing, and at what expenditure of fuel. I have but time to send you a brief abstract; the results are most satisfactory. The steam was kept up for 6 hours and 16 minutes, or 6·26 hours.

The coke consumed during that time was 526 lbs. To which add for getting up the steam, which was done in 32 minutes, 62 lbs. } Total—588 lbs.=5¼ cwt.

The load drawn was 28 tons, 1 cwt. and about 10 passengers, say 28·5 tons in all; equal to 960½ tons drawn during the experiment: viz.

28·5 tons carried	30·813 miles	878·7 tons.
7·5 do.	3·224 do.	24·18
17·5 do.	3·3205 do.	58·11
		960·46 tons carried one mile.

The blowing apparatus being constantly at work, the average consumption of coke was 84lbs. per hour: viz. $\frac{526 \text{ lbs.}}{6{\cdot}26 \text{ hours.}}$=83·9lbs. Now, the average of the speed of the engine between the quarter mile-posts, was 8·05 miles per hour, with a load of 28·5 tons; therefore 28·5×8·05=229·425 or 229¼ tons, carried 1 mile with 84lbs. of coke. Consequently

$$\frac{83{\cdot}9 \text{ lbs. coke}}{229{\cdot}425 \text{ tons}}=365 \text{ or } \tfrac{2}{11} \text{ of a pound per ton per mile.}$$

The distance from Liverpool to Manchester being 31 miles, the quantity of coke necessary to convey a ton that distance, will be 365×31=11·315 lbs. which at 10s. per ton, is ·6106*d.* or ⅗ths of a penny per ton for the whole distance. If we add one-fifth for stoppages at each end, and getting up steam, the amount will be ·6106+1221=·7327, or *under ¾d. per ton for* 31 *miles*."

INTERIM NOTICES.

Mr. Lubbock has published in the last No. of the Philosophical Magazine, a paper "On the tides in the port of London," which is intended to confirm the accuracy of his investigations and computations in the "Companion to the Almanac." It bears the most unequivocal marks of that gentleman's wonted philosophical acumen and correctness. We hope to give it a cursory examination early enough for our next Number.

Errata.—Page 405, col. 1, in the *sixth* description of lines the word '*cuspidal*' should have been '*nodated*.'

Page 406, fig. 6, the parabola marked 'F' should have been 'B.'

S. Y.—Yes.

Communications received from G. C.—Lancaster—Mr. Dowling—S. P. B.—Dr. Fox—Mr. Harvey—Mr. Huyter—Littoralis—A Naturalist—Mr. J. Gilbert.

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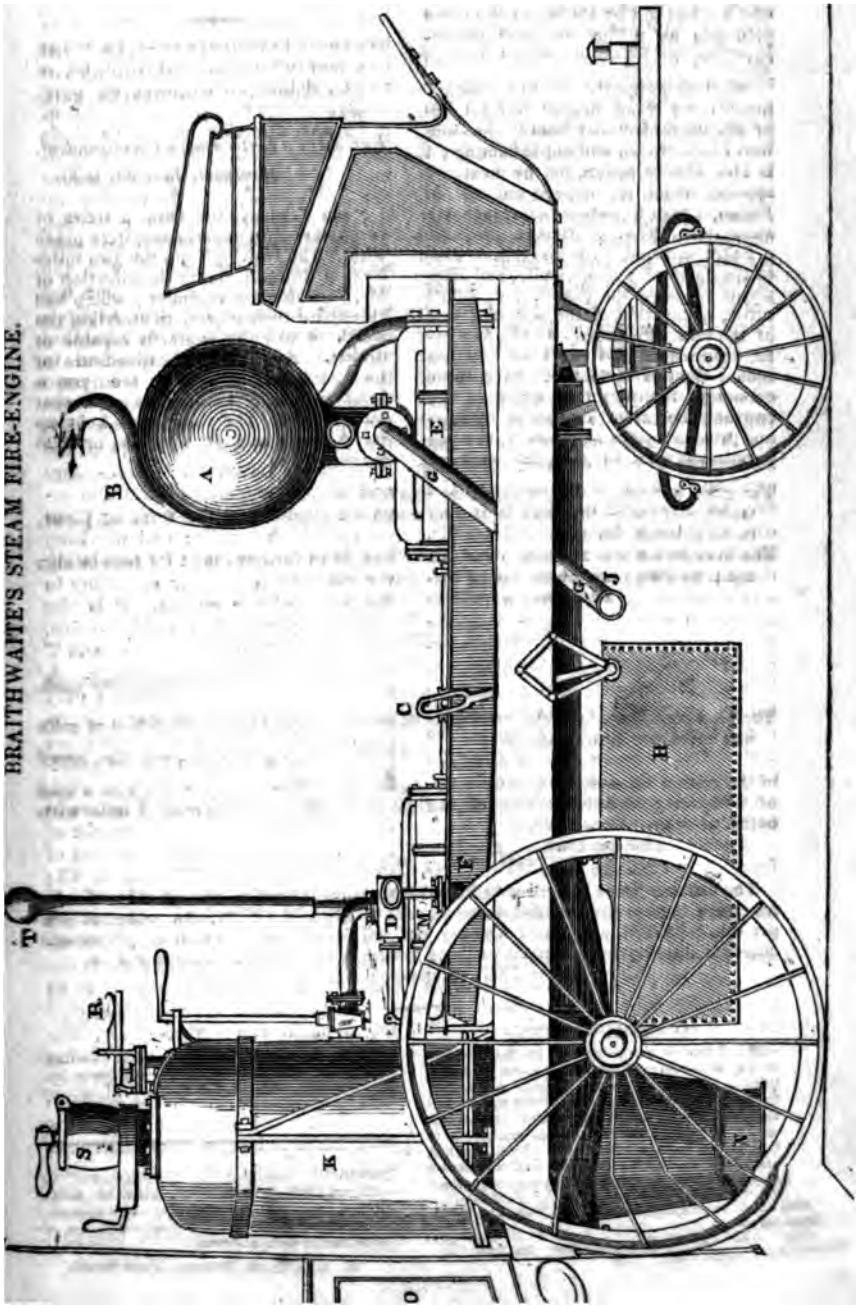
BRAITHWAITE'S STEAM FIRE-ENGINE.



BRAITHWAITE'S STEAM FIRE-ENGINE.

SHORTLY after the conflagration broke out, to which the Argyle-rooms fell a prey on Friday last, a new fire-engine, worked by steam, on the same principle as "The Novelty" steam-carriage, and manufactured by the same ingenious and enterprising engineer, made its appearance on the scene, under the direction of Mr. Alfred Braithwaite, and earned for itself universal admiration, by the powerful services which it rendered on the occasion. It was worked incessantly for nearly five hours: discharged upon the burning pile and adjacent buildings from thirty to forty tons of water per hour: and sent its jet of water completely over the dome of the building, a height of at least eighty feet. We have seen it stated in some of the newspapers that none of the engines was able to reach the dome; but this statement can only be correct as regards the old engines. Several gentlemen, who were present at the fire, have assured us, that they saw distinctly the water ejected from Mr. Braithwaite's engine quite over the dome; and one of the same individuals previously witnessed a private trial of the engine, when it threw water over a pole ninety feet high, erected for the purpose of the experiment. The expenditure of fuel to produce these wonderful effects was only about three bushels, during the whole five hours; and the help of *two* men only sufficed to keep the steam up, and superintend the working of the engine.

The strong interest which the performances of this new fire-engine have excited, has induced us to lose no time in making ourselves acquainted with the details of its construction; and it is with much pleasure we are thus early enabled to present our readers with the very correct engraving on the preceding page, and the following descriptive particulars.

In all that regards the generation and application of the steam, the same contrivances are adopted in this engine as in "The Novelty;" but there is a difference in the form of some of the parts, and in the general arrangement. The furnace and boiler, K, are exactly the same as those of "The Novelty," but of less power. The hot air-pipe, instead of being vertical, has received a serpentine form, (B) which adds much to the appearance of the engine in point of elegance and compactness. This pipe has also been made to turn on a swivel, so that the engineer or driver of the carriage can turn the mouth of it in any direction which he finds most convenient. The blowing-apparatus is here placed in front under the driving-box, and is worked by the tappet-lever C. The cylinders, M, are placed horizontally; and each steam-piston is connected with the water-pump (E), plunged by one rod working through the two stuffing-boxes, so as to form its own parallel motion. A cross-head, attached to the piston-rod, sliding on the frame which supports the two cylinders, works the tappet-lever C, connecting with the slide D, the feed-pump F, and the blowing-apparatus. The feed-pump and blowing-apparatus have also separate appendages for working them by hand occasionally; and provision has been farther made for regulating the stroke of the former according to the work of the engine. P is the mercurial-guage, R the safety-valve, S the feed-box to the furnace, and T the eduction or waste steam-pipe. A box, O (owing to want of room only partially represented in our engraving), serves to hold the coke or other fuel, and as a platform for the assistant engineer.

The steam-cylinders are 7 inches in diameter; the length of the stroke of the pistons 16 inches; the number of strokes per minute from 35 to 45; the power barely 6-horse.

We come now to the parts of this apparatus peculiar to it as a fire-engine. The globe or sphere A, is the air-vessel; the water-pump E is 6½ inches in diameter; the oblique pipe GG, is one of the suction-pipes. The action of the water-pump being double these suction-pipes, either connect with the tank H, or in the common way at J. The object of having the tank H, is to enable other engines to supply this one with water in situations—such as narrow streets and alleys—where a supply of water, close at hand, cannot be obtained.

But it must not be supposed from this, that there is any necessity for placing this engine in a particular situation, in order to connect it directly with the water-mains. Its suction-pipe is a common perforated rose, and it may lie in any part of the water-way with the suctions of other fire-engines, and take its supply from the same source. It worked with one jet only at the late fire; but is constructed to operate with one or two jets, as occasion may require.

The total weight of the machine, with its complement of fuel and water, is incredibly small; not more than 45 cwt.

Although the engine we have now described is the first of the kind which has been brought into public operation, it has, we understand, an elder brother, of still greater capabilities. The other engine we allude to is stated to be of 10-horse power, and capable of throwing *ninety tons of water* per hour, either by one large jet or by four smaller ones. A private trial of it was made lately in the presence of a number of gentlemen connected with the Fire-offices; when the only exception taken to it was expressed in the shape of an apprehension that it would be found, in reality, *too powerful*. We presume that what was meant to be said was, that a ton and a half of water ejected per minute in a single jet might as readily knock down some houses as preserve them from the flames; and there is no doubt such would often be the case. But as this body of water can be as conveniently discharged in four different jets as in one, there can be no serious reason to apprehend any actual inconvenience on this score.

MR. LUBBOCK'S SUPPLEMENTARY DISQUISITION ON THE TIDES.

Another paper from the pen of that ingenious and profound investigator, Wm. Lubbock, Esq., F. R. S. Almanac-computer for the Society for the Diffusion of Useful Knowledge, &c. &c. on the subject of the tides, appears in the last Number of the "Philosophical Magazine." The manifest purpose of *this paper is to vindicate* himself as well *as he can from the charges* of ignorance *and blundering* which we had brought against him (for by nobody else have his computations been found fault with): yet with a candour which throws even his modesty into the shade, he carefully refrains from any *literal* reference to the journal which has *extorted* from him this supplementary vindication! By thus omitting to name his assailants—to specify to what particular bill of accusation his vindication has reference—he has reserved to himself the power (a power which he has very freely exercised) of noticing such points only of the case against him as it suits him best to notice; the power also of sheltering himself afterwards under any form of excuse for his silence in regard to other charges—as that he was not aware of their existence, or had overlooked them, or thought them beneath notice, or any thing else equally satisfactory and true. People may say, perhaps, that Mr. Lubbock has been thus enabled to shape his defence more according to his own convenience than to the facts of the case; that a person who felt justly confident in his strength, would have met his antagonists manfully, face to face and foot to foot; and that no one who had devoted himself with high-mindedness and sincerity to the diffusion of useful knowledge, would have sought to draw a veil even over the slightest of his own errors. But what will not people say? We live in a world full of narrow notions, and volunteer public instructors are not to be judged of by vulgar rules.

Mr. Lubbock commences his defence with again adverting, for the purpose of indirect censure, to "the studious secrecy" of the computers of tide-tables published in this country. Now, we should be glad to know why the calculator of a tide-table, any more than the manufacturer of a water-proof hat, or water-proof boot, should reveal to those who will, in consequence, oppose him in his calling, the secret of his art? If the banking-house of Lubbock and Co. have any mode of getting money peculiar to themselves, is there any want of liberality or of honour in their not sending a circular to every banking-house in the metropolis to show how the gain is effected? But is there really so much "secrecy?" Are there not many well-known rules and tables for computing high-water, as those of Heath, Robertson, Mackay, Garnett, Brisbane, Mendoza Rios, the "Imperial Almanac," &c.? Some of these rules are very excellent and scientific: four, at least, of them involve the principle of Mr. Lubbock's table, given at p. 5, "British Almanac;" and even the worst of them

as we shall soon see, will give the time of high-water (the effects of winds and land-floods excepted) within a quarter of an hour, when what is denominated "the establishment of the port" is correctly assumed. For aught Mr. Lubbock knows to the contrary, some of these rules may be employed by other computers; and whether the fact be so or not, his querulous tones are much out of place.

We have long thought that the *transcendent* mathematics of the present day often leads its votaries astray from practical common sense, and Mr. Lubbock's mode of writing is an illustration. His sentences are usually so unconnected, that it is difficult to reduce to order any remarks upon his performances. We will endeavour, however, to notice what is most important.

He says, "as long as the bed of the river continues the same the tide will be *regularly* transmitted to any point of it, modified only by an alteration of the constant quantities in the formula which the theory gives. This will be the case, even if we suppose the tide which we have here to be compounded of two tides, which arrive by different courses, and after different intervals, as *might very easily be shown* to follow from the nature of the expression, by which the height of the water at a given place is represented." Since this is so "easily to be shown," we regret that Mr. Lubbock did not attempt it, with an especial reference to our objections at p. 295, No. 332. His quotation from Laplace bears scarcely more upon the point than a quotation from Hoyle's "Laws of Whist." Mr. Lubbock is, however, so firmly persuaded that the sequence of the tides should be "as regular" in the port of London as in the ocean, that he is positively blind even to the evidence on the subject which his own paper presents. He gives a table of the times of high-water, morning and afternoon, for the first 13 days of the present year, as observed at the London Docks and at St. Katharine's Docks (the latter being about half a mile nearer London Bridge than the former), from which it appears that no less than *seven times* in the 13 days, the high-water was *earlier* at the docks *most remote* from the Nore than at those lower down, while on the other six days the high-water occurred first at the lower docks! Yet this strange circumstance, far from startling Mr. Lubbock, seems to be regarded as a proof of a *regular* transmission! But, in truth, nothing seems to move this gentleman from his imperturbable serenity. He mistook (or his informer did) Rotherhithe for Wapping church; but this point, though he "regrets it," can, he assures us, "be of no consequence whatever!" He disregarded the declinations of the sun and moon, and he neglected the equation of time; he neglected *half* the observations, and so on: but (p. 126, No. 38, "Phil. Mag.") all these things, he farther tells us, "CAN *have no perceptible influence!*" No: nor can any other blunders, or any other neglects, render Mr. Lubbock's results less worthy of confidence than they now are.

But it appears, that our objections to applying Laplace's theory "to places separated from the main ocean by long and narrow channels, as is the case in the port of London," are nugatory, because the times of high-water occur *as regularly* in the Thames as in the sea. Indeed! then what becomes of the effect of the *wind* in different reaches of the river? What of the effect of *freshes* and *land-floods?* And how happens it, that in many parts of the river, the tide continues to *flow upward* for twenty minutes, or half an hour, and sometimes more, after the *surface* of the water has begun to descend? Some of our papers in subsequent Numbers, in reference to the effects of the old bridge, may farther exemplify this. Meanwhile, we may adduce two or three proofs of the want of that regularity which Mr. Lubbock believes to exist, notwithstanding the evidence to the contrary adduced by himself.

Deptford Dock-yard is, we believe, from 3 to 4 miles lower down the river than the main entrance to the London Docks. Now, we have had an opportunity of comparing the times of high-water at those two places, from authorised records, twice every day, for the months of July and November last; and though, as might naturally be expected, the high-water occurs usually earlier, by from 10 to 20 minutes, at Deptford Dock-yard than at the London Docks, yet, on July 4th, 6th, 8th, 11th, 12th, 16th, 17th, 18th, 22nd, and 23rd, and November 6th, 18th, 20th, 27th, and 28th, the times of high-water are recorded as *precisely the same* at both places; while on July 20th and 21st, and November 2nd, 21st, 22nd, 25th, and 29th, the high-water occurred *earlier* by some minutes at the London Docks than at Deptford: on three of these occasions the difference was *more than half an hour!* These discrepancies are doubtless in some measure owing to carelessness in the records, and that at

the London Docks, especially, shows some great irregularities; but others are manifestly to be imputed to the effects of winds and land-floods, and are totally ruinous to Mr. Lubbock's theory of *regular transmission*. But what will not a mere theorist do to resist the impression of facts when they run counter to his notions of differentials and Laplace?

Mr. Lubbock, referring to his mean result from observations (9·52452) of which we spoke at p. 312, No. 333, says, "this mean result is not affected by the neglect of the equation of time." Of course not, according to Mr. Lubbock's notion of things; nor would it if the equation of time had sometimes been 16 *hours* instead of 16 minutes. But a crude notion is one thing, and a clear principle is another; and they do not often co-exist in the same mind. Without dwelling, however, upon the neglect of the equation of time, are there not other circumstances which may affect the *mean* result, besides those specified in our former articles? Is it *quite* clear that the time of high-water is always the same (or that it always varies by a *regular* difference) in the mid-stream of the river and at the gate of the main entrance of the London Docks? Will they be the same whether the gate be sometimes shut and sometimes open, or always open, or if both the main entrance-gate, and the Hermitage-gate, be both constantly open, the tide freely entering one gate and passing out at the other? A cautious investigator would hesitate upon all these points; but to each Mr. Lubbock would most probably reiterate, "this is"—"this *can* be of no consequence whatever."

Mr. Lubbock proceeds, if we rightly understand him (p. 137) to admit that "the neglect of the equation of time" is "*perhaps* perceptible in the table at p. 66." In the "Companion to the Almanac," p. 61, he remarked, "the effect of the change in the sun's declination is *clearly perceptible* in the table, pp. 66, 67." *Then* he seemed confident, *now* he is in doubt. Both causes have manifestly operated in producing the palpable irregularities of that table; and more than either, most probably, the defective observations and the unscientific mode of deducing the means. In January and July, the sun's declinations, south and north, are nearly the same in magnitude, and the equation of time is of the same *kind* in both, varying in January from 4′ to 13′, in July from 3′ to 6′. *Yet, when the moon* culminates at noon, we have in January for the quantity preceding, 2h. 5m., in July 1h. 28m.! So again, in May and July, we have against corresponding hours, 2 10, 1 28; 1 49, 1 35; 0 45, 1 15; 0 48, 1 20; 0 40, 1 21; &c. Other irregularities the reader may trace at his leisure. The general result is, that from a series of mere *arithmetical* means of numbers occurring most irregularly, and varying from 0h. 29m. to 2h. 22m.—the means themselves again varying in the twelve months from 1h. 13m. to 2h. 56m.—he infers a value of $^{*}\lambda - \lambda'$, that is, in plain English, of the establishment of the port=2 hours! We will venture to say that Mr. Lubbock would have ascertained this fact, in a far more satisfactory manner, by asking any waterman who plies at Hermitage-stairs, what is the usual time of high-water at new or full moon, at the London Docks: but then what would have become of the 9000 observations of the rival clocks at Rotherhithe and Wapping churches, and of that ingenuity which has contrived to exhibit at pp. 66, 67, differences for *every hour* of the twenty-four, when by the investigator's own acknowledgment, the observations during the *day-light* hours only were regarded.

We feel, however, that we may be thought to resist conviction, when we make these strictures in the face of the table in the "Philosophical Magazine," where Mr. Lubbock compares the times of high-water for 13 days in January with the announcements for the same days in the "British Almanac." We have already adverted to one strange irregularity in this table, with reference to the times of high-water at St. Katharine's and the London Docks. Let us now add, that 13 days, with the river clogged with ice, are not sufficient for a fair trial; that Mr. Lubbock's application of the equation of time to columns computed as *his* were, is questionable; that his mode of taking the mean is often fallacious; and that other tables to which his are opposed, when tried by the same test, give better mean results. Thus, taking White's "Ephemeris" for example, deducting from each time of morning high-water, 30 minutes, the difference between $\lambda - \lambda'$ at the London Docks and at London New Bridge, and adding to the sum of the 13 times, 1h. 24m. for the correction of equation of time, the amount is 69h. 33m.; while the amount of the *observed* times at the

* Very distinguished mathematicians, like Mr. Lubbock, can make no progress without the aid of Greek letters.—What pedantry!

London Docks was 69h. 30m. Mr. L.'s amount is 70h. 10m.: hence, while his mean error is, by his own showing, 4 minutes, the mean error in White is only *a quarter of a minute*. Proceeding in the same way with *Bulpit's* table of high-water at the East India Docks, using 20 minutes for the difference of $\lambda - \lambda'$ at the East India and London Docks, and omitting the correction for the equation of time, Mr. Bulpit's table being given for mean time (as we would venture to suggest it would be better to make *White's* in future) the amount is 70h. 13m. and

$$\frac{70\text{h. } 13\text{m.} - 69\text{h. } 30\text{m.}}{13} = \frac{43}{13} = 3 \text{ min.}$$

nearly, for the mean error. The individual differences are less variable in Bulpit's columns than they are in the "British;" and the whole work, though infinitely less pedantic, we doubt not, is more correct and useful than the result of Mr. Lubbock's hard labour upon numerous observations.*

Thus far, the comparison shows that White's and Bulpit's tide-tables are both better than Mr. L.'s, according to his own criterion. But we may proceed a step farther, and show, that one of the oldest, and probably one of the least scientific rules for finding the times of high-water, gives *a better* mean result, than can be extracted by Mr. Lubbock from good observations, collected in 24 years, methodised carefully by Mr. Dessiou; notwithstanding the aggregate advantages of "the kind interference of Captain Woolmore," "the superintendence of Captain Eastfield," the valuable mass of advice supplied by "the Committee of Superintendence," Euler's thin medium revolving about the sun, "*Materia subtilis in gyram acta*," &c. differentials, Greek letters and accents, and (let it not be forgotten) the church clocks of Wapping and Rotherhithe.

Heath, in his "Royal Astronomer," published 70 years ago, remarked, that at London the high-water at the moon's quadratures did not happen 6 hours, but usually *about* 5 *hours* later than at the preceding new and full moon; and from this observation, he presented in one of the annual numbers of his "Palladium," this rule:—*Five hours* divided by the interval in days, from new or full moon to the succeeding quarter, gives the average daily addition to the high-water at the said new or full moon till the quarter. And, *seven hours* divided by the interval in days from first or last quarter to the succeeding full or new moon, gives the average daily number (in minutes), to be substracted from the time of high-water at full or new moon, back to the preceding quarter.

A skilful computer would, of course, change the average numbers thus obtained by slight differences, so that, while the mean result remained the same, they should run in a regular progression; but, without having recourse to this expedient, we have for the times of high-water on the successive days:—1st. 6h. 17m.; 2nd. 7h.; 3rd. 8h.; 4th. 9h.; 5th. 10h.; 6th. 11h.; 7th. 0h.; 8th. 1h.; 9th. 2h.; 10th. 2h. 43m.; 11th. 3h. 26m.; 12th. 4h. 9m.; 13th. 4h. 52m. The amount of all these is 69h. 27m.; the amount of the observed times 69h. 30m. Thus, this avowedly grossly approximative rule, supplies an average result *nearer by* 40 *minutes than the result of Mr. Lubbock's recondite speculations*, even according to his own test.

After writing the preceding remarks, we thought it might be worth while to compare also the observed times of high-water at the London Docks for the first thirteen days of the present year, as exhibited in Mr. Lubbock's last paper, with the observed times at Deptford Dock-yard; and such as the result is, we lay it before our readers (confining ourselves, however, to the morning column merely). On the 3rd, 4th, and 12th January, the time of high-water is recorded to have been precisely the same at both places, though, as before stated, the one place is between 3 and 4 miles lower down the river than the other. On the 5th, 10th, and 13th, it was high-water only five minutes later at the London Docks than at Deptford; on the 6th, 7th, and 9th, fifteen minutes later; on the 8th, twenty-five. On the 10th it was high-water at the London Docks at 2h. 35m.; at Deptford at 2h. 40m.; that is to say, soonest by five minutes at the place which the tide reached last. The difference between the time of high-water on one day, as compared with the day following, varied

* The following remark in Mr. Bulpit's pamphlet may possibly be instructive to Mr. Lubbock, and his friends of the Diffusion Society:—"In the Blackwall-reach of the Thames, the stream of flood, in strong spring-tides, begins to *run* up about 4h. 20m. before high-water, and *ends* about 40m. *after* high-water, when the tide *has fallen about one foot* at the dock-gates."

at the London Docks from 30 to 95 minutes; at Deptford from 20 to 75 minutes. What a host of additional facts within the short space of 13 days, to *exemplify* the great feasibility of Mr. Lubbock's theory of "regular transmission!" and the correctness of the observations of which he makes such a parade!

A FEW QUESTIONS TO MR. GURNEY.

Sir,—If you can spare a few lines for a few words for a constant reader of yours, in your next magazine, I shall feel much obliged I observe in your last, a communication from a certain Mr. Herapath, relative to Mr. Gurney's steam-carriage. I really have not time to enter into the merits or demerits of the aforesaid engine, but wish to propose a few questions for his and Mr. Gurney's consideration.

1st. Will the said carriage go (once within a week) from Paddington to Finsbury-square, turn round the circle, and return to Paddington, without stopping, and carrying a weight in the omnibus equal to twelve passengers?

2nd. Can Mr. Gurney's coach do the above distance in one hour?

3rd. What will be his consumption of fuel?

4th. What will be the pressure of his steam?

5th. If he does the journey ONCE, will he repeat it four times in each day for one week?

6th. Did he ever yet go twenty-five minutes without stopping?

7th, and lastly. *How many times did he stop in going round Hounslow-barracks*, to *point* out to his Grace the Duke of Wellington the *beauties* of his machinery?

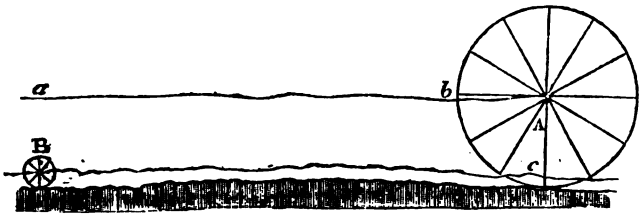
I remain,

Your obedient servant,

INQUISITOR.

In Nubibus, Feb. 10, 1830.

ON THE ADVANTAGES OF LARGE WHEELS AND BENT AXLES.



Sir,—When drawing up the account of wheel-carriages, which appeared in your 325th Number, I made a sketch of the lines described by the centres of wheels of different sizes, on roughly-paved roads; but, considering my description so plain as to render this unnecessary, and being unwilling to occupy too much of your valuable pages, to the exclusion, perhaps, of more interesting matter, the sketch did not accompany that communication.

Your correspondent, "BENEVOLO," has, however, thought otherwise, and has at p. 389, supplied what he considers a deficiency. Unfortunately, however, his *illustration* makes a sorry contrast with my description: for he has delineated a portion of a *smooth*, though unlevel road; upon which, above all others, the difference in the size of wheels will be least advantageously displayed.

I at first supposed that your correspondent was making game of me and my wheels; but he is so serious withal, that I cannot entertain this opinion. However, *his illustration* is just such as will enable any one to

"Confute, change hands, and still confute."

I feel myself, therefore, under the necessity of requesting your insertion of this letter, with the accompanying diagram, which will "serve to illustrate" my former assertions, much

better than that supplied by "BENEVOLO."

Referring your readers to p. 174, I need only quote part of my former remark, wherein I stated, "that in passing over a *rough* or *unevenly*-paved road, (such as yet abound in many parts of the metropolis*) a small wheel sinks into every little hollow, and the axle, if noticed, would be found to describe a line almost as curved and irregular as the surface of the road."

The truth of this assertion is satisfactorily established by the line Bc in the accompanying sketch, which is the line actually described by the centre of the small wheel B in passing over the roughly-paved road, which is there represented. This wheel may be supposed to be one foot in diameter, such as is frequently used for the fore-wheels of low chaises.

Again, "a large wheel on the same road would be affected but slightly by its inequalities, and the line described by the axle would be found to deviate but little from a straight line." This I consider also incontrovertibly established by the line *a*, *b*, which is that described by the centre of the large wheel A (about 7½ feet diameter) in passing over the same road as the smaller one. This line is, in regard to the inequalities of the paving, a straight line—curved only where the road deviates from the level.

"BENEVOLO" might well observe, looking at *his illustration*, "that the difference between the line formed by the centres of the large and small wheels, is not so great as Mr. B.'s letter would lead one to imagine!" I would now ask, is it not quite as great?

But the delineation of the lines described by the centres of wheels in passing over rough roads, is so easy, that I need not farther trespass upon your columns.

Permit me to say, I felt great pleasure in perusing the interesting communication of Mr. Murdoch, on the advantages of large wheels, at p. 183; and also Mr. Thingk's (Knight's?) description of the Guernsey cart, in your last Number: which affords a practical proof of the advantages attending the adoption of the BENT AXLE, which I so strongly recommended at p. 204.

The ingenious contrivance for loading and unloading, with which your correspondent was so much struck, has for many years been used in London by the Phœnix, Royal Exchange, and London Assurance Fire-Offices, for raising and lowering their engines into and out of the carts in which they are conveyed about town. In these the *inclined planes* and the *windlass* are applied exactly as is the Guernsey cart; and I can only wonder, that our cart and waggon-builders have not, ere this, perceived the great advantage and convenience which this simple addition to their present construction would afford.

I remain, Sir,
Yours respectfully,
WM. BADDELEY, Jun.
Jan. 25, 1830.

* *And of which the prefixed is by no means an exaggerated representation.*

EFFECTS OF DIFFERENT WINDS ON THE COLOURS OF VAPOURS.

Sir,—The first article of your miscellaneous column, p. 320 of No. 333, inquires concerning the "*effects of different winds on the colours of vapours*;" rather by a statement, however, than a question. "*Different winds*" no farther effect the "*colours*" of a hemispheric medium, or floating "vapours," than by rendering them more or less dense: all the various effects of *colour* being entirely produced by the influence of light, and all being explainable by the *proved axiom*—"that *the ray of reflection and the ray of incidence always form equal angles from the surface reflected on.*" And with regard to the various apparent colours of "distant hills," all substantial bodies resign their local appearances, according to the proportion of their distances; and their evidences of unevenness soften through the perspective diminution of the parts into *apparent* smoothness, and consequent glossiness, until finally, in the *extreme* distance, a mountain assumes the apparent texture of a cloud both in substance and colour. The degree of glossiness is not solely to be

attributed to smoothness and moisture of the snow, as found on the continental mountains, but to that effect of smoothness which is produced by distance, becoming thereby an *effectual* mirror; and conveying the colour of the sky, or clouds, to the spectator's eye *by reflection*. The softening or the lowering effects of *density* of the atmosphere must be considered, according to its degree, *along with*, and *not in opposition to*, this radical cause of *distant* colours. In conformity with the above conclusions, all the variety of colours seen on distant objects, either clouds or mountains, are mathematically accounted for: for instance, suppose the general slope of the side of a mountain, which we conclude to be a prism, lay at an angle of 45° from the level line of view, it would reflect to the spectators whatever colour might happen to be perpendicularly over it, and so *ad infinitum*.

I am, &c.

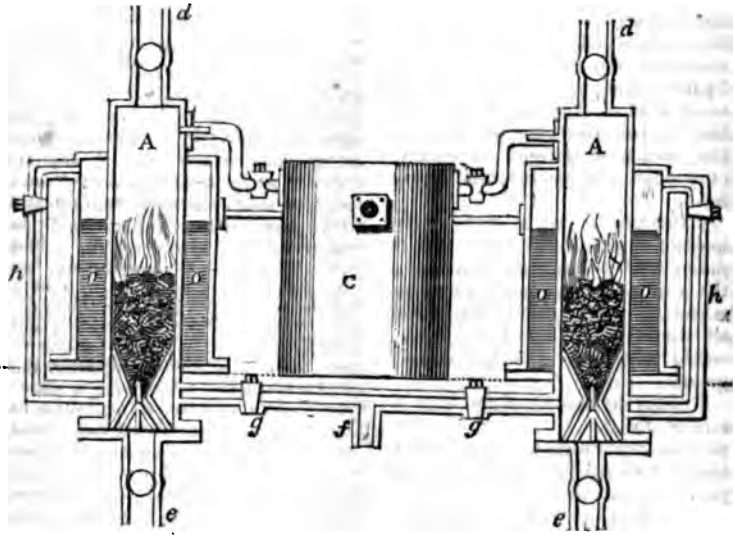
CHARLES HAYTER.

16, *Cirencester-place*,
Dec. 28, 1829.

HALL'S STEAM AND GAS ENGINE — CONTRASTED WITH GILMAN'S STEAM-GENERATOR.

Sir,—In your publication of 5th Dec. 1829, there are drawings and an explanation of an apparatus, denominated "Gilman's Steam-Generator," which your correspondent seems to give to the world as original, commencing — "In 1826 my attention was directed, &c." Having accidentally in my possession No. 52 of the "Register of Arts and Sciences," *Sept.* 10, 1825, I am induced to send you a few extracts, leaving it to your readers to compare them with the above-named communication.

HALL'S PATENT STEAM AND GAS ENGINE.



As I have only copied the perpendicular sections, a part of the apparatus referred to in the following extracts is not shown:—

"A A are two furnaces, with a cylindrical boiler surrounding each; B is a cistern of water to supply the boilers; and C is a reservoir for the reception of the *steam and gases generated*. The intention in having two boilers is, that while one is being replenished with fuel, the other may al-

the same time be employed in the generation of vapour, and thereby keep up the supply to the engine equal and unremitted."

"The figure of the furnace is that of a hollow cylinder; it is made of great strength, and all the joints are very firm and air-tight. The grating upon which the fuel rests is peculiar, being similar in shape to a double hopper: it is supplied with coke, or other fuel, through an aperture *d* at the top of the furnace; and the dust and ashes are raked out from underneath by a properly-formed iron through the aperture *e*. Both these apertures, *d* and *e*, are furnished with large stop-cocks of sufficient capacity for the reception of the coke, and for the discharge of the ashes and clinkers, as often as may be necessary; and the furnace-cylinder is by this contrivance kept air-tight when the cocks are shut."

"OO is a hollow cylindrical vessel encompassing the furnace, made of sufficient strength to bear a great pressure of steam; *f* is a pipe, to which is connected a pair of strong blast bellows, or other blowing machine, for the purpose of increasing or accelerating the heat in either of the furnaces; the pipe *f* is therefore furnished with stop-cocks at *gg*, that either of the fires may be operated upon, which they are alternately, in the process of working the apparatus."

I think the foregoing extracts are enough to explain the sketch; but it appears that the patentee also lets a portion of steam under the grate by the pipe *h*, which passes through the ignited fuel, and is partly decomposed; forming altogether a heterogenous, expansive mixture, from which he derives power at the smallest possible expense of fuel.

I have been induced to take the trouble of transcribing the above, on the old English principle that a looker-on has a right to see fair play; and the circumstance of the date would give to Mr. Hall the merit of first using the decomposed atmospheric *air (or the nitrogen)* along with high-*pressure steam*. I shall conclude *with a quotation from a keen observer of human nature*, where he says,—

"Man's a strange animal, and makes strange use
Of his own nature and the various arts,
And likes particularly to produce
Some new experiment to show his parts;
This is the age of oddities let loose,
Where different talents find their different marts:
You'd best begin with truth, and when you've lost your
Labour, there's a sure market for imposture.

"What opposite discoveries we have seen!
(Signs of true genius, and of empty pockets,)
One makes new noses, one a guillotine,
One breaks your bones, one sets them in their sockets;
But vaccination certainly has been
A kind of antithesis to Congreve's rockets."

As your work appears to be conducted upon the principle of fair play and free discussion, I doubt not but you will insert this; by doing which you will oblige,

Yours, &c.

J. SYNGLEMAN.

Derby, Jan. 5, 1830.

DANGEROUS EFFECTS OF THE REMOVAL OF THE OLD LONDON BRIDGE.

Now that the New London Bridge advances to its completion, and the Old one is on the point of being removed, the London public is beginning to manifest a degree of anxiety about the effects which these improvements — if such they must, in courtesy, be called—are likely to have on the trade and navigation of the river, which, though sufficiently laudable, is, it must be confessed, somewhat of a posthumous description. "*Better late than never,*" said the man who discovered that he had built a house without a chimney—"*'tis lucky the fires were not lighted.*" Not much discreeter, we apprehend, has been the conduct of those who have had the sway in this bridge-building affair. "Build, build the bridge, and make it high and spacious," seems to have been all the cry: but what the effect might be of substituting a structure which should give a free course to the stream, for one which has served for centuries as a dam to the upper waters, seems never to have been once thought of, or, at least, not to have been deemed worth a serious thought. And now that this reckless course of proceeding is beginning to threaten a thousand awkward consequences, all the consolation the authors of it have to offer us is an echo of the blunderer's remark on forgetting the chimney—"We have built a new bridge, to be sure, without caring for the river; but,

better late than never; *'tis luckily thought of before the dam was actually removed.*"

We do not mean to say that it is now too late to find a remedy for any injurious effect which the erection of the one bridge and the demolition of the other are calculated to have on the river; we desire merely to hint how much wiser it would have been to ascertain distinctly the probable consequences of both measures before they were resolved upon, and before a million and a half of money was expended upon them.

But was there really no previous inquiry? Oh yes, Inquiries and Reports in abundance. But for any regard that was paid to the facts elicited by these Inquiries and Reports, they might as well have never been made.

The reason assigned for building a new bridge in the preamble of the Act of Parliament obtained for the purpose is, strange to say, a concern for the very thing which has been, in truth, so much disregarded—*the navigation of the river.* "Whereas the great fall of water at certain times of the tide, occasioned by the large starlings and piers of the said bridge, renders *the navigation* through the said bridge dangerous and destructive to the lives and properties of his Majesty's subjects." Now, the evidence* brought forward in support of this preamble proved no more than that in the course of the preceding *twenty* years, *seventeen* lives and *four thousand* pounds' worth of property were lost by accidents at London Bridge—accidents, too, which were not all attributable to the piers and starlings, many of them being caused by inebriety and carelessness. The evidence failed besides entirely in showing that it was by the "starlings and piers," the "great fall of water at certain times of the tide" is "occasioned"—the superior height of the bed of the river above bridge having more to do with the fall than either. The evidence, in short, proved this only—that the preamble was all a sham. We seldom hear, now-a-days, of accidents at London Bridge, and for a very plain reason—there is no longer any bridge-job to be promoted.

Had a concern for the navigation of the river been really the governing motive of the projectors and promoters of the new bridge, they would have considered it their duty to look at the effect which the old bridge, with its piers and starlings, has on the navigation, in all points of view, and not have seized with such avidity on a few shreds of evidence, bearing only on a particular aspect of the case. They would have inquired whether these much-inculpated piers and starlings did not cause something else besides a few "moving" accidents to his Majesty's subjects; whether they did not, by obstructing and suspending the return of the water at each ebb of the tide, make the river ten times more valuable to all that part of the metropolis above the bridge, than it would otherwise have been; and whether, in fact, it was not absolutely essential to the general prosperity of the trade of the upper part of the Thames, and to the very existence of much of it, that the dam thus accidentally (perhaps) occasioned, should be permanently maintained. But why do we say they should have inquired into all this? They did worse than *not* inquire; they had it incontrovertibly proved in evidence before them that the *navigation* above bridge would, in truth, be ruined by the substitution of any new bridge which was not accompanied by some plan for maintaining the old dam; and yet they acted just as if no such evidence had ever been tendered!

First of all, there was the evidence of the celebrated Smeaton—a higher authority than whom in matters of this sort never existed—who laid it down as a matter of perfect certainty, that "if London Bridge were to be taken away, the river would become so shallow above bridge at low-water, *that the navigation would be greatly impeded for hours each tide.*"*

Next, there was an elaborate Report from Mr. Telford, who stands by universal consent at the head of living engineers, in which he showed, 1. That were the old bridge removed, "the velocity of the ebb above bridge would materially increase, and the time of low-water be earlier than at present." 2. That the "navigation which is now practicable up to Teddington† would cease too early near that place." 3. That "the bed of the river would be left nearly dry for several hours in the latter part of the ebb." 4. That though these evils would in part be remedied by "the increased velocity and momentum scouring away the mud, sand, and

* *Report of Committees of the House of Commons, 1800—1801.*

* "Smeaton's Reports," vol. ii. p. 78.

† Said to be so called (Tide-end-town) from its being the farthest point to which the tide extends.

small gravel, so as to deepen the bed"—yet that this lowering of the bed would "seriously affect" the foundations of some of the other bridges—those of Blackfriars', Waterloo, and Westminster, in particular; cause settlements of the wharfs and houses on the banks of the river; walls to be undermined, &c. And, 5. That "all the river above bridge"—"all the banks and low-grounds on each side from Westminster to Teddington"—will when the dam is removed be more liable to be overflowed by high tides, and be "exposed to the influx of heavier waves driven from the Nore with storms from the northward, which have hitherto been checked by the almost solid mass of the upper part of London Bridge."

There was, thirdly, the corroborative evidence of Dr. Olinthus Gregory, who to great knowledge and much sagacity, adds a peculiar acquaintance with every thing relating to the River Thames and its banks—an acquaintance more extensive and circumstantial, we believe, than is possessed by any other individual of the present day. The opinion of Dr. Gregory, as stated by our intelligent correspondent, O. C. F., in our 335th Number, was to this decided effect—that "after the removal of the old bridge the bed of the river between its site and Westminster Bridge would often at and near low-water *be dry, and the navigation completely at a stand.*"

Many similar opinions by individuals, only second in weight to those we have named, might be quoted; but is not the fact, that the warnings of such men as Smeaton, Telford, and Gregory, should have been passed over wholly unregarded—that they should not have induced even the slightest precautionary measure—quite sufficient to show, that had there been a body of similar evidence as bulky as the old bridge itself, it would have been all to no purpose? A new bridge was to be built at all events, and only those portions of the evidence which favoured that project—no matter how slender or how equivocal they might be—were to have any regard paid to them. The evidence of the lowest waterman on the river who could swear that a fraction of a man per annum and a fraction of a pound per day were lost by accidents at the old bridge, was as a matter of course to be treated as decisive of the fate of that ancient structure: while all that the first engineers and philosophers of their time could say of the thousands of individuals and millions of property dependent for subsistence or preservation on the continuance of the existing state of the river, was to go for nothing.

But what was there in the preservation of the dam caused by the old bridge which made it inconsistent with the project of a new one? Strictly speaking, nothing at all. Dr. Gregory, while he represented the great evils that might result from the removal of the old bridge, pointed out at the same time how they might be effectually obviated in the erection of a new one (see "Mec. Mag." No. 335, p. 339). Inconsistency in the case there was none; it was convenient to keep the utility of the dam out of sight, and that was all. It would doubtless have been as good a job to build a new bridge with sluicegates in the way proposed by Dr. Gregory as without them; but so weak was the case for taking down the old bridge, so slight the testimony on which its "dangerous and destructive" character rested, that to have invited or encouraged attention to the good it did, might have endangered the job altogether.

(To be concluded in our next.)

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

(Continued from page 429.)

Wheels are classed into three kinds, according to their position; as, when the teeth are on the edge they are called spur-wheels, or spur-gear (gear being a general term for all wheel-work); when they are perpendicular to the wheel they are called crown-wheels, and they are bevelled-gear when the teeth are placed obliquely to the wheel.

The second class of elementary machines (viz. the cord) is now to be considered. It is this which has been generally called the pulley, although the cord is a better term for it, as the mechanical virtue does not depend on the pulley, but on the cord. The general principles are these:—A cord is supposed, in mechanics, to be *perfectly* flexible. If two forces that are equal act in opposite directions on the same point, they will keep each other in equilibrium, and produce no effect, whatever the nature of the point, whether solid, fluid, or even gaseous; but if

they do not act on the same point, but at distant points of the same body, they will or will not neutralise each other according to the circumstances. If the body be solid they will do so, in whatever direction they act, whether in the directions of any of the arrows in fig. 1; for by the definition

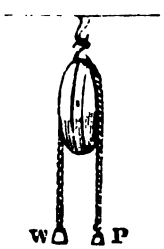
Fig. 1.

before given of a solid, it is incapable of either compression, extension, or flexure. If the body be a rope they will do so, if the forces act in the directions A*a* or B*b*, for a rope is supposed to be incapable of extension; but if they act in the opposite directions the rope will be compressed, and the forces will not neutralise each other's effects.

Another principle is its perfect capability of transmitting force in the direction of its length and from its ends.

A form in which the rope is applied is the pulley, which is composed of a hollow shell, called a block, with a grooved wheel acting inside, and called the sheaf. In the simple pulley, as fig. 2, a string is passed over

Fig. 2. Fig. 3.

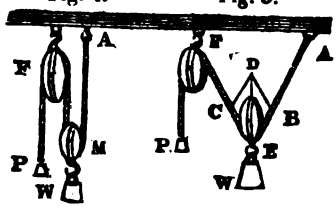


this sheaf; to one end of which is suspended the power P, and to the other the weight W.

Pulleys are divided into two sorts; viz. fixed (fig. 2) and moveable (fig. 3): the names of which will sufficiently indicate their nature.

In the fixed pulley, the power and weight must be equal; for from the

Fig. 4. Fig. 5.



definition of the rope before given, each part of the string will be equally stretched by the power, and also by the weight, consequently they must be equal. It may be asked, of what use is this pulley? Its object is principally to change the direction of the force, which is often of material consequence. Thus, if a weight were required to be raised, a person acts to considerable disadvantage when raising any weight; but by means of a fixed pulley, a force applied in a downward direction (which is most effective) will raise the weight. Thus the object of a fixed pulley is merely to change the direction of a force, and no other mechanical advantage is gained by it.

In a moveable pulley, however, there is a power gained; fig. 4 is a view of one. It will be seen that one end of the cord is fixed to the point A, and is continued round the *moveable* pulley M; thence over the fixed pulley F. The power being suspended at the end P, the weight W is suspended to the moveable pulley M. It is evident that the pulley M must move upwards with the weight, on the power being drawn downwards. Now, by the definition of a cord, the tension of all the parts will be the same. As the weight is supported by the two cords (for they may be supposed to be unconnected) AM and FM, and each cord supports the same weight they must each support $\frac{W}{2}$; and as the power and weight are both equal when they are supported by a fixed pulley, the cord FP is also stretched with the same tension as FM; consequently P must be equal to $\frac{W}{2}$, or the power is equal to half the weight.

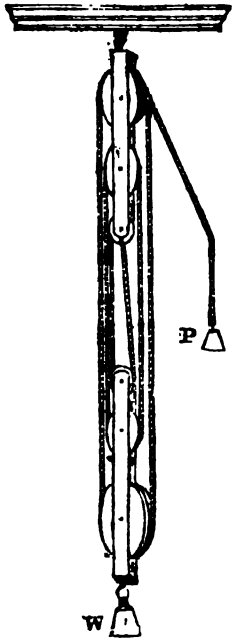
It has been asserted by some that

the pulley depends, for its principles, upon the lever; but this can be proved to the contrary: for the same principles will be true, even if a point be supposed to be the pulley, and there can be no lever in that case.

In the last case, the strings were supposed to be parallel: the next proposition for consideration is, when they are not so. Let fig. 5 be the pulley, and let AE and FE be the two directions of the strings: draw the parallelogram BECD; and if the sides BE and CE represent the tensions of the strings, the diagonal DE will represent the power.

It is evident from the foregoing cases, that in a single pulley the proportion between the power and weight can never exceed 1 to 2; but by combining a number of wheels in the same block, a very great degree of power can be gained. Let fig. 6 be

Fig. 6.



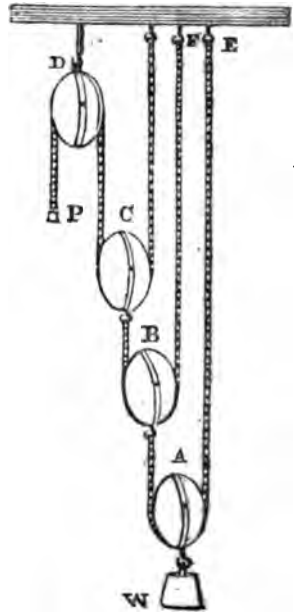
a system of pulleys consisting of three wheels: for determining what proportion the weight bears to the power, it will be as well to trace the progress *of the* strings over the wheels. The end of it is fastened to the pulley C, and is passed under D; up again over C, under E; up again over B, from thence it proceeds under F, then over A; and on the other end is suspended the power P. Now the weight is suspended by six strings; and as they are each stretched with the same tension, each string will be stretched with a tension equal to one-sixth of the weight: therefore the weight will be equal to six times the power.

In general, the power is to the weight as the number of wheels in both blocks is to unity.

One objection to these machines is the friction, which is very great; every wheel having a separate axle, which must be taken into account.

The same observations apply to this machine as were before mentioned. A small force appears to balance a great weight: the weight and power are both thrown upon fixed points, which support them both. In the case of lifting—1 lb. weight raised 20 feet, requires the same force as 20 lbs. raised 1 foot, which is exactly the same thing that is effected by the pulley: it effects by gradual efforts

Fig. 7.



what could not be done by a single exertion.

In the last cases there was but one string: now let there be more than one. Let fig. 7 be a system of pulleys, consisting of three moveable (A, B, and C,) and one fixed (D). Now, if the weight be supposed to be 8 lbs., it is plain that it is supported by the two ropes EA and BA; consequently they each support half that weight, or 4 lbs.: but the 4 lbs. supported by BA is also divided between the lines CB and FB, therefore they each bear a tension equal to 2 lbs.; and in like manner it can be shown, that the string DC bears a tension of 1 lb., and by means of the fixed pulley D, the power of 1 lb. will balance a weight, W, equal to 8 lbs.

(To be continued.)

EXTRACTS FROM MY NOTE-BOOK.

No. 4.

(Concluded from p. 264.)

On the Heat evolved from Metals by Percussion.

According to the experiments of Bertholet, and others, it appears that by percussion the greatest heat is evolved from copper, the next from silver, and the least from gold. The specific heats of these metals follows the same order. The specific heat of copper, according to Dulong and Petit, is 0·0949; of silver, 0·0557.

The heat evolved from copper by percussion was 26·28°; from silver, 13·10°.

Hence it appears that the heat evolved from metals by percussion is in the direct proportion of their specific heats.

On Atomic Proportions.

The determination of the atomic proportions in a compound, the proportionate weights of whose constituents are given, is a problem of frequent occurrence. The rule given for this purpose by Dr. Ure ("Dictionary," art. Equivalent), is long and tedious.

For the following simple rule, I am indebted to the polite communication of Dr. Thompson:—"Divide the weights of 'the constituents' by the atomic weight of each. The quotient gives the ratios of the atoms, which you can easily reduce to simple terms."

On Light and Shadow.

The "Philosophical Magazine and Annals of Philosophy" for February, 1829, contains an interesting communication from Joseph Reade, M.D. I had intended to repeat the experiments, but have been prevented by one cause and another. With the hope that some of your readers will do what I have neglected, and communicate the result to your Magazine, I send you two or three condensed extracts.

"Experiment 1.—Having placed a table at about ten feet from a well-lighted window, I placed on it a candle in a high candlestick. I now held a quire of white paper parallel to the table, and rather close to the blaze, when two shadows were produced by means of a piece of coiled paper held immediately near the quire; the one next to the candle was a bright orange, the other a bright blue. On turning the quire of paper towards the window, so as to cut off the light of the candle, this orange shadow changed to a perfect black; and on turning the paper towards the candle and excluding the light of the sun, the blue shadow likewise changed to a perfect black."

In two other experiments, orange and blue were produced; these caused a green by overlapping. By altering the distance of the paper the orange was changed to yellow and brown; the blue to violet and indigo. On these results Dr. Reade observes, "As to the idea that black proceeds from the absorption of the seven rays of compound light, it is completely upset by these experiments; for we cannot suppose that the quire of paper was at one moment an absorbing substance, and at the next a reflecting one; therefore we must admit, contrary to the opinions of Boyle and Newton, that black is as much a reflected and independent colour as blue, red, or any other of the seven."

I am, Sir,

Yours, &c.

H. Horwood.

Carmarthen, Jan. 3, 1830.

QUESTION PROPOSED FOR DISCUSSION AT THE INSTITUTION OF CIVIL ENGINEERS.

Is there any substance of less specific gravity than brick, that is equally incombustible, and as applicable for use in fire-proof floors?

MINOR CORRESPONDENCE.

Thermometric Phenomenon.—Sir, On Sunday, Jan. 10, I observed a phenomenon so rare, as to deserve recording. At mid-day, Fahrenheit's thermometer indicated 36°, with a sharp north wind and a clear sky. Now, though the thermometer was 4° below the freezing point, there prevailed a hard black frost; the ice in the puddles was perfectly black, and the road as hard as stone: in short, it was freezing fast at the time. —I have every reason to rely on the correctness of the thermometer, which had a north aspect sheltered from the wind. No doubt, the frost was occasioned by the rapid current of air which swept along the road, and from which current the thermometer was free. Every body knows how much colder a wind is to the feel than a calm, though the thermometer may indicate the same temperature in both cases; but I never yet saw an exemplification of it similar to the one mentioned here—it may be equally new to many of your readers, whose amusement is the object of,

Yours, &c. J. B. Jun.

Camberwell, Jan. 24, 1830.

Jones' Cylindrical Iron Wheels.—The use of these wheels appears to be now becoming very general in the metropolis, particularly among brewers, distillers, coal merchants, &c. A correspondent, at Hull, requests we will suggest to the patentees the propriety of taking some steps to introduce them throughout the country—"the expense of carriage, and the difficulty which may attend the repairing of them at a distance from town, preventing country persons, like himself, from availing themselves of this admirable invention."

Jackson's Patent Studs.—(From R. W. 30, K. S.)—"Mr. Editor, As much has been said concerning Jackson's Patent Studs, in your interesting work, allow me, through the same medium, to apprise your numerous readers, that these *Studs* are not *sold;* but if you wish to avail yourself of the benefit of the invention, you must send your boots and shoes to the patentee to have the Studs put in. The cost, I understand, is 1*s.* 6*d.* (by no means an exorbitant charge): but would not the patentee reap more benefit from his invention by selling the Studs *alone* to such as are or may be inclined to purchase them? I live at some distance from the metropolis, and would avail myself of the proprietor's ingenuity, but for the expense of carriage to and from London, together with the expense of studding, which would, at the lowest calculation, be 4*s.* 6*d.* per pair. Since I first entertained the idea of writing to you, I have learnt that no patent has been taken out for the invention, and that a Tradesman in our neighbourhood will make some slight improvement in them, and establish an agent in London, as also all the large towns in England, for the sale of the Studs."

[Our Correspondent has been misinformed; there is an existing patent for the Studs in question, which it will be dangerous, we apprehend, *to infringe*.—EDIT.]

MISCELLANEOUS.

Men-of-War's Boats.—A new mode of constructing boats for ships of war has been invented by Mr. Johns, of Plymouth dock-yard. There are no timbers used, all the planks coming up from the keel to the gunwale, diagonally, not very stout, but rendered strong by being again crossed by others, diagonally placed, but in the opposite direction. The boat so constructed is stronger than the ordinary one now in use; the seams never open in straining, which prevents leakage; and another great advantage is that she is only half the weight of one on the old construction of the same size. The planks are all fastened together by copper nails, thickly set. There has been a boat of this construction on trial attached to the Britannia, 120, and although in constant use for eighteen months, it has not required any other repair than the gunwale streak."—*United Service Journal.*

Sparkles in the Sea.—The phosphorescent-like lights observed in the Mexican Sea, shine with greater brilliancy (in April) than any other part of the ocean; and this, I can assert without mistake, as I bestowed great attention on the subject, and had the acquiescence of others. Some of these lights were very large, and flashed like the priming of a cannon, sometimes at a long distance from the vessel. I observed that the little shining sparkles were here confined to the sides of the vessel and her wake, and that the waves when they broke into foam *did not sparkle*, which is quite different from what we had noticed before in the passage out, and in the Carribean Sea Contrary to Dr. Franklin's assertion, the sparkles are seen in the water of the Florida stream as in other parts of the ocean.—*Correspondent of the United Service Journal.* The statement of Dr. Franklin, to which this contradiction is offered, was in these words:—"Having crossed this stream (Florida) several times; in passing between America and Europe, I have been attentive to sundry circumstances relating to it, by which to know when one is in it; and besides the gulf-weed with which it is interspersed, I find that it is always warmer than the sea on each side of it, and *that it does not sparkle in the night.*"

The Pantouranion.—A valuable astronomical instrument, invented by Mr. W. Shires, the mathematical tutor, in January, 1829, has been since improved by the same author, and rendered capable of finding its own meridian, the right ascension, declinations, longitudes, and latitudes of any celestial object; the day of the month and hour; the hourly, daily, and annual variations; the state of refraction, moon's parallax, and precession of the equinoxes. It will also direct the observer in finding any planet, &c. mentioned in the "Nautical Ephemeris;" will point out the fixed stars, foretell eclipses, and, in a word, will form of itself a complete observatory. The instrument is an improvement on the equatorial of Mr. Shires; the principle of which, as first conceived, was explained to the Western Literary Institution, and in the "Mechanics' Magazine," No. 297, for April, 1829.

INTERIM NOTICES.

Januarius—Certainly not.

Communications received from J. G.—S. Y. —Mr. Baddeley—T.—Mr. Jopling—A. B—Mr. Gray—Mr. Thorold—R. L. D.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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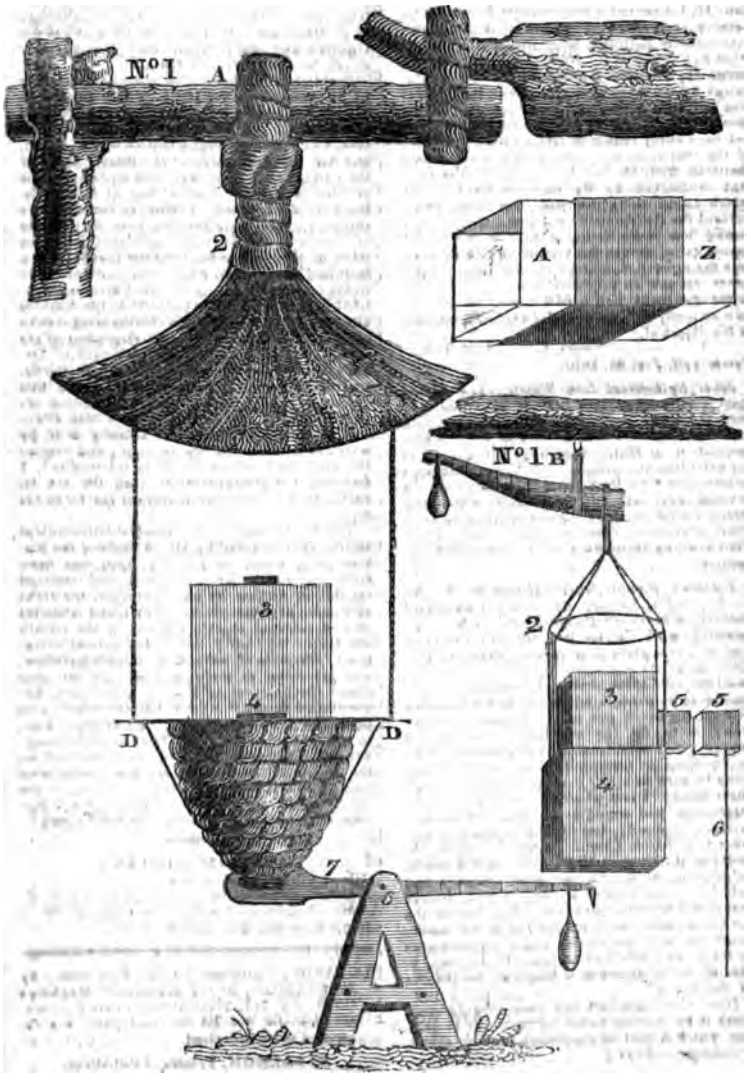
NUTT'S COTTAGE BEE-HIVE.



NUTT'S DOUBLE-COTTAGE IMPROVED BEE-HIVE.

Sir,—The "Improved Bee-House," published in the "Mechanics' Magazine" of July 4, 1829, is, I think, a very pretty toy: but as I am induced to believe that it is essentially necessary for the entrance into the hive to be stationary, and that the bees, if possible, should have the sun to shine upon them from morning till evening, I do not very well see how it can answer the purpose intended.

But if, in some respects, I undervalue Mr. Saul's beautiful box, I really feel much obliged to him for having given me the idea of so hanging my hives, as that without the least inconvenience, and at no additional expense, they may be weighed by any child of ten years old, the motion not being perceivable by the bees.

Among the many discoveries and improvements that are daily taking place in this *gallop of intellect*, perhaps nothing is more deserving of praise from the labouring-classes of society for the services rendered them, than is the new method of managing bees by Mr. Thomas Nutt, of Moulton Chapel, Spalding, Lincolnshire.

Above £300,000 a year is said to be paid out of England for the importation of foreign wax and honey. Till now, bees have had attention bestowed upon them, as ants have had, and little more, *i. e.* by a few persons curious in natural history: but the management of them has never yet been taken up as a consideration of general interest and profit—I had almost said as of national importance.

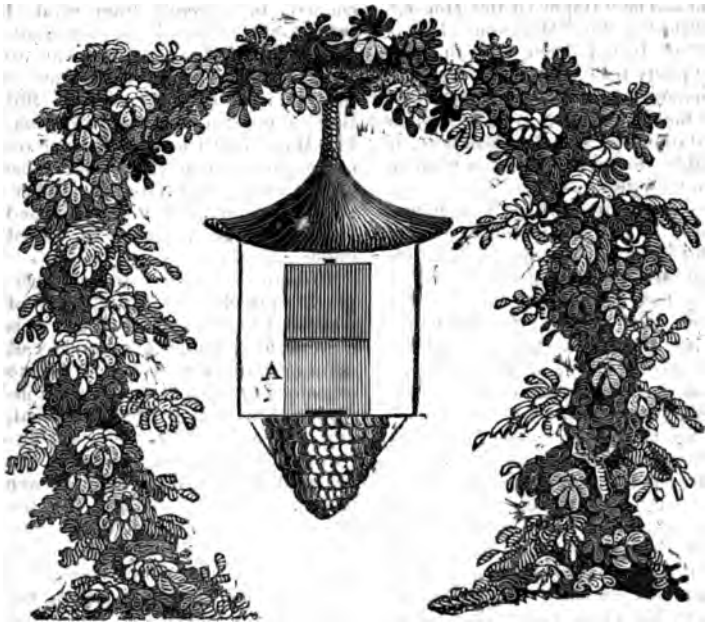
Are they to remain for ever, or any longer neglected, standing upon the damp, dirty, rotten bench of the labouring man, now that it has been satisfactorily proved to us, that by this new mode of looking after them, they have already in one instance produced—and that in a *most unfavourable year—four hundred pounds weight of honey from one swarm:* six swarms producing, *in the same year*, 1192lbs.; and of so superior a quality, that four times the usual price was paid for what was offered for sale? Are we *still to introduce* foreign wax and *honey*, when at home we can supply *the quantity* required, and of a quality by no means inferior to any we import? Is charity so dead in the country, that merely from want of being better informed, the poor, hard-working man shall still continue to struggle on, when so easily his lot may be improved? I trust not. But through the medium of your invaluable Magazine, I hope, Sir, so to recommend this new plan to the notice of the public, that it may be universally inquired after, and be adopted in every village throughout the united empire.

If there be any merit in the principle of the double-cottage hive, of which I now send you a sketch, it is due to Mr. Nutt. The method of managing them I leave for him to explain, as I think it would be an injustice to rob him of the benefit that, I trust, he will derive from the discoveries he has made.

His plan, however, I think I have greatly simplified. By removing the benches, I have ensured the cleanliness of the hives; that they shall be kept dry; and that all insects shall be kept from them. And by placing the steelyard under them, as they hang either suspended from a rope, or branch of a tree, from the beam of an outhouse, or are supported by props, it can be certified what progress they make, if necessary, ten times a day, in as many minutes. The expense of the rope is trifling; and even that might be almost altogether done away with, as a few nut-sticks, wattled together, would serve the purpose equally well. If this hive did not hang under a shed—which is recommended—a piece of painted canvas, an earthen pan, or thatch, might be placed over the top of the box to throw off the rain, &c.

It will be objected against me, that if we collect such enormous quantities of honey, the price will so fall, that it will not be worth a farthing a pound. To this objection I answer, that I am much mistaken if, by leaving a proper supply of honey for the bees during the winter, they may not be made to furnish wax to a very considerable amount; for which there will be always a demand that will ensure its being a good marketable commodity.

A spirit also of a very superior quality



may be made from honey. Again, as in the hive itself, do we not see in every class of society the drones as well as the workers? Are there not many persons that no spur to industry will make industrious? No; there is no fear of there being too much honey, *and still less of there being too much wax.* When the price will no longer but remunerate the poorest of the people for their toil, the business will fall into the hands of those only who are content to gain the merest trifle: but, at least, let us encourage this branch of industry amongst *our own poor*, till we have driven entirely from our markets *all foreign supplies*—for, were we only to benefit the labourer, or mechanic, by showing him how he may add a trifle more per annum to his wages, it would be no small advantage; but we should, moreover, in a very considerable degree, improve their general habits, by introducing so moral a lesson to their attention; and the interest they would take in ornamenting their little gardens, *would greatly* add to the beauty of the country. *Every grain of mignonette-seed sown in the garden is an additional support to the hive of the labouring man.*

The hives that I recommend may be placed, like a bird-cage, at a window, only by *hanging* them on the steelyard from the beam, instead of *raising* them by the steelyard when weighed. And if brought close to the window, the bees can go out and come in without the least inconvenience; they may be looked after by the cottager's wife, or the mechanic, without leaving the house, or by any infirm person unable to leave the room. *I have known twenty hives to be kept by a shoemaker in a small back-court, not twelve feet square, at the back of his house, and in a town: they may even be kept in a garret, in the middle of a large town.*

Persons of no mean name or rank, from the desire of doing good to their labouring poor, have already honoured Nutt with their patronage; such as their Royal Highnesses the Duke and Duchess of Gloucester, the venerable

Earl Fitzwilliam, Lord Viscount Milton, Lord Baron Stafford, the Hon. Mrs. Fraser (near Inverness), Lady Stapleton, S. Price, Esq. (Ireland), besides many others, who are causing Nutt's plan to be made known: but, Sir, from you I expect much more good may be done, if you will have the kindness to make known in your Magazine the purport of this letter.

I am, Sir,
Your obedient servant,
P. MASSINGBIRD.

Gunby Park, Spilsby, Lincolnshire.

Description of the Engravings.

No. 1, A. The beam of an outhouse; or a strong pole supported from the branch of a tree, or by a prop.

No. 2. At this point the rope divides into four parts, passing over a hoop covered with thatch, canvas, &c.

No. 3. A deal-box 12 inches cube, standing on a board, full an inch thick, planed off fine to throw off the rain, &c., under which is placed a straw hive, or box. The hive should be white-washed, to destroy eggs and insects. The boxes, No. 3, may occasionally require an additional box to be placed under them, as is seen in the cottage-hive A (p. 451).

No. 4. The entrance for the bees; 4 inches long, ¼ high.

Nos. 6 and 7. A moveable frame, upholding the steelyard D. The hive is kept close to the board by two staples DD, a rope passing underneath. The board should be two feet square.

N. B. Simple as these double-hives appear, Thomas Nutt must be consulted before they can be made to produce, as his have done, 400 pounds of honey in a very unfavourable season.

A double-hive for the interior of a labourer's or mechanic's cottage-window.

No. 1, B. A notched stake, supported from the beam of a room, serving instead of a steelyard; and from which hangs the double-hive or box.

No. 2. A hoop to extend the ropes.

No. 3. A box 12 inches cube. The *tops* of the boxes should always be screwed, and not nailed down.

No. 4. A box in which the bees are collected at swarming-time.

No. 5. A spout, divided in the middle, by which the bees enter No. 3 from the window.

No. 6. The cottage-window.

No. 7. The spouts as they appear when covered over with a piece of leather, to prevent the bees from coming into the room; while, at the same time, sufficient motion is allowed to the boxes to be weighed by the steelyard. A, the end next to the box, No. 3. Z, the end next to the window.

The sketch A (p. 451) represents one of these new-invented double-cottage hives, with hops (or other creepers) growing up the poles. Twelve of them thus placed in a ring would greatly ornament a flower-garden; and they might easily be removed, if required, to a white clover field in season, and there suspended by three poles.

OLD LONDON BRIDGE.

Sir,—I wish I could read without concern what you and your correspondents say about pulling down the old bridge. But my property lies too near the river for me to feel quite at ease; and, though I am no philosopher, nor even a mechanic, yet, as a reader of your Magazine from the beginning, perhaps you will forgive me if I ask for a spare corner.

I was much struck with what the Woolwich gentleman said about the sluice-gates; and I am inclined to think it would only be going back to old ideas. When I was a youth, several of the arches of the old bridge were called *locks*, some of the smallest had gates, and others had remainders of strong iron-hinges.

Now, I have been thinking that with a view to provide against the apprehended evils, it would be well, on pulling down the old bridge, *to leave five or six of the piers and starlings standing*, at nearly equal distances. Then, if it should be necessary to have sluice-gates below the new bridge, there would be, at least, *some* piers ready, with a little chipping, and paring, and facing, as a substantial basis for the work. To prevent mis-

chief at night, they might be suitably lighted; and in the day-time they would occasion no harm.

I know of no objection to this precautionary measure, except it be one (which is possible), that it would save time and expense. But there may be objections of greater weight than this; and if so, I am sure that either you or your correspondents will bring them forward. You, I observe, never flinch from declaring the truth, when the public is to be benefited thereby; and I can bear it for the public good: so if my notion is good for nothing, show it, and thus oblige

Your constant reader,

ISAAC SUMNER.

Bankside, Feb. 16, 1830.

LONDON BRIDGE—VELOCITY OF THE TIDES.

Sir,—In common, I doubt not, with many of your readers, I have had my mind deeply impressed with the momentous consequences which may be expected to follow the removal of the old London Bridge. My thoughts had been, in some measure, directed to the subject many years ago; but your remarks in reference to it, and those of your correspondent, O. C. F., with the known and recorded opinions of Dr. Gregory, Mr. Telford, and others, have revived the train of thinking, with great additional energy, and lead me to trouble you with this communication.

Well, indeed, will it be, if men in authority, both in the Government and in the City, will address themselves to the inquiry in good earnest; and by resolutely opposing all jobs, and all employment of needy speculative men, and employing simply men of competent theory, and good practical common sense, devise some means of preventing the mischiefs that may otherwise result from the removal of the old bridge.

By the way, why may not five or six of the piers be left, when the old bridge is taken down? They may be removed after a year or two, if experience proves that they will not be wanted. This, however, is not my present business.

Another question is more to my immediate purpose. Why are not means taken to approximate to the actual quantity of tidal water that passes through London, or Blackfriars', or Waterloo, or Westminster Bridges, or all four every hour, or every half hour, during the flowing and ebbing-tide? The thing would require skill, care, and caution; but it is quite accomplishable, and it would be worth a thousand mere guesses. If this were done at spring-tides, neap-tides, and midway-tides, the real effect of the old bridge in keeping up the water would soon be pretty well known.

I remember about thirty years ago, when Telford and Douglas's design (magnificent indeed, so far as the architecture was concerned) for a bridge of one arch was in agitation, that many fears, similar to those which are now beginning to prevail, were entertained by thoughtful men, as to the injury which the navigation of the upper river, and the commerce by the side of it, might sustain, by the removal of so great a dam as the bridge has, in fact, been for six or seven centuries.

Two of my friends laid a plan for a series of experiments on the velocity of the tides, day after day, in different parts of the stream from side to side, and at different depths. The design of the iron-bridge of one arch, however, was abandoned; and my friends, in consequence, lost the motive to proceed with their experiments. Still they made a beginning; and I am enabled to communicate the result, which, I have every reason to believe, has never been published.

They caused a boat to be anchored in the middle of the river in Lambeth-reach, not far from the Archbishop's palace; and having a very excellent contrivance for measuring the velocity of the stream, either at the surface, or at any depth beneath it, at pleasure, they patiently commenced and pursued their labour.

They took the day of *full moon*, and the day of the *last quarter*, in June; which though not the days of highest spring-tides and lowest neaps, were only two or three days from either. They ascertained the depth of the water in the middle of the

river, at the end of each half hour commencing with the beginning of the flood, and the mean velocity during each half hour at the depth of a foot below the surface. The following are the results:—

FULL MOON: FLOOD, OR RISING TIDE.

Time from begin. of Flood.		Depth of the River.		Mean velocity, feet and decim.
H.	M.	Ft.	In.	
0	0	3	10	0·00
0	30	6	0	0·57
1	0	7	0	1·44
1	30	8	10	2·78
2	0	11	6	2·87
2	30	14	0	*3·04
3	0	*14	9	2·94
3	30	*14	9	2·25
3	50	13	9	1·50

The greatest *velocity* was at 2h. 30m.; the greatest *depth* between 3 hours and 3h. 30m.: after which the depth† diminished about a foot before the tide ceased to flow.

FULL MOON: EBB, OR FALLING TIDE.

Time from begin. of Ebb.		Depth of the River.		Mean veloc. feet & decim.
H.	M.	Ft.	In.	
0	0	13	6	0·04
0	30	12	3	0·77
1	0	11	4	2·21
1	30	10	9	*2·35
2	0	10	0	2·33
2	30	9	4	2·28
3	0	8	9	2·18
3	30	8	3	2·12
4	0	7	9	2·04
4	30	7	0	1·93
5	0	6	3	1·77
5	30	6	0	1·74
6	0	5	9	1·73
6	30	5	3	1·65
7	0	4	9	1·60
7	30	4	3	1·54
8	0	4	0	1·45
8	10	*3	10	1·38
8	30	4	2	1·22
8	40	4	2	0·66

† This confirms the remark of Mr. Bulpit, quoted at p. 438, of our last Number. Perhaps some of our correspondents may favour us with an explication of this curious phenomenon.

Here the greatest *velocity* was at 1h. 30m. the *least depth* at 8h. 10m. about half an hour before the surface of the water became stagnant.

LAST QUARTER: FLOOD, OR RISING TIDE.

Time from begin. of Flood.		Depth of the River.		Mean veloc. feet & decim.
H.	M.	Ft.	In.	
0	0	4	0	0·00
0	30	4	4	0·41
1	0	5	3	1·07
1	30	6	1	1·21
2	0	7	8	1·72
2	30	9	0	2·08
3	0	10	0	*2·36
3	30	11	2	2·24
4	0	*11	9	2·00
4	30	11	2	1·13
4	40	11	0	0·88
4	50	10	9	nearly stags.

Here the greatest *velocity* was at 2h. 30m. as at the full moon observation, but their ratio as 23 to 30. Here, also, the greatest depth was 50m. before the ebb commenced.

LAST QUARTER: EBB, OR FALLING TIDE.

Time from begin. of Ebb.		Depth of the River.		Mean veloc. feet & decim.
H.	M.	Ft.	In.	
0	0	10	9	0·00
0	30	10	0	1·08
1	0	9	3	1·76
1	30	8	6	*1·93
2	0	7	9	1·89
2	30	7	2	1·90
3	0	6	8	1·84
3	30	6	1	1·80
4	0	5	8	1·65
4	30	5	2	1·60
5	0	4	10	1·58
5	30	4	6	1·58
6	0	4	2	1·55
6	30	3	11	1·50
7	0	*3	10	1·28
7	15	3	11	0·60
7	25	4	0	0·20
7	35	4	2	stagnant

The observers and recorders of high-water may hence learn that there are at least *two* circumstances to notice—the precise time when the *depth* of the water is the greatest, and the precise time when the tide in a river ceases to flow upward, and the upper surface becomes *quiescent*. These will be found to have a variable interval in different states of the tide.—Ed. M. M.

Here, again, the greatest *velocity* was at 1h. 30m., and about *five-sixths* of the greatest velocity of the tide of flood. The *least depth* was about half an hour before the water became stagnant.

Many of your readers, even your London readers, have, I dare say, no idea, that the river at low-water is not in the mid-stream *four feet deep*, just above Westminster Bridge. Let them call to mind that, at spring-tides, the *fall* through London Bridge is from 4 feet 4 inches to 5 feet 7 inches,* and then they may form a tolerable conjecture as to what *must* happen when the dam supplied by the old bridge is removed. Surely, it is not the characteristic of the inhabitants of this great metropolis to sleep upon the brink of a precipice.

But, I leave all farther remarks to those who are more skilled in such subjects than I am,

And remain, Mr. Editor,
Yours, &c.
SILAS THORNDIKE.

Feb. 16, 1830.

P. S. If any of your readers should prefer the velocity in miles per hour to the miles in feet per second, they will at once find it by this rule, given in the book just quoted, viz. "*two-thirds* of the feet per second will give the miles per hour;" but in the present case, the measure feet is, in my judgment, best.

* See Gregory's "Mathematics for Practical Men," p. 314.

BRAITHWAITE'S STEAM FIRE-ENGINE.

Sir,—I was delighted with the excellent description of Mr. Braithwaite's steam fire-engine, in your last number; but, as I think you have somewhat misunderstood the remark, made by the gentlemen connected with the fire-offices—"that the steam fire-engine of ten-horse power would be found in reality *too powerful*," permit me to say a few words thereon.

In the first place, however, let me say that I am decidedly of the same opinion as those gentlemen; not from any apprehension that the large stream of water would do much mischief in the way of knocking down houses; because we have a few floating fire-engines on the River Thames, and in some of the docks, which will throw a similar body of water, and have frequently done so, without producing any such destructive effects. In fact, the stream of water is generally suffered to take its greatest point of altitude, and then fall gently into the fire: which it does in a spreaded and divided state, owing to the great assistance which it meets with from the atmosphere, and which, at an elevation of about eighty or ninety feet, disperses it in a fine spray.*

The reason the steam fire-engine would be too powerful is, that our present arrangements will not, generally, supply the necessary quantity of water. It is this consideration, principally, that prevents our land fire-engines from being made larger than we at present see them. On the river, where a copious supply of water can always be depended upon, there we already have fire-engines of great power.

Of these floating-engines, that belonging to the London Assurance Corporation is, I believe, generally acknowledged to be the best. It has three working cylinders, seven inches in diameter, the pistons having twelve-inch strokes. It is worked, not by an alternating motion, but by four cranks, each ten feet long, and furnished with a fly-wheel upwards of five feet diameter. These cranks are turned round by any number of men under fifty, and communicate by means of toothed-wheels, with a three-throw crank, which works the piston levers. This engine can use one or more branches; if one only is used, the nose-pipe is one-inch diameter: and this large stream of water can be thrown from eighty to ninety feet high.

As these engines can only be used at fires in the immediate vicinity of the water-side, they are but seldom called into operation; many persons are not only ignorant of their extra-

* I would respectfully call the attention of Mr. Braithwaite to my remarks on this subject at p. 61 of your 9th vol., and should he have an opportunity of observing any facts likely to give the information there solicited, I am sure he will feel great pleasure in transmitting an account for your insertion.

ordinary power, but even of their existence.

In my humble opinion, the steam fire-engine of six-horse power is quite as large as can be generally useful in the metropolis—the floating engines afford opportunities of enploying steam power to an unlimited extent.

Wishing Mr. Braithwaite that success which his laudable and enterprising ingenuity so richly merit.

I remain,

Yours respectfully,

W. BADDELEY, JUN.

DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. VIII.

Pile-Machinery — The modern Machine described—Care necessary in Foundations—Wren's reason for rejecting Pileing in parts of St. Paul's Cathedral.

(Continued from p. 427.)

Fig. 1.

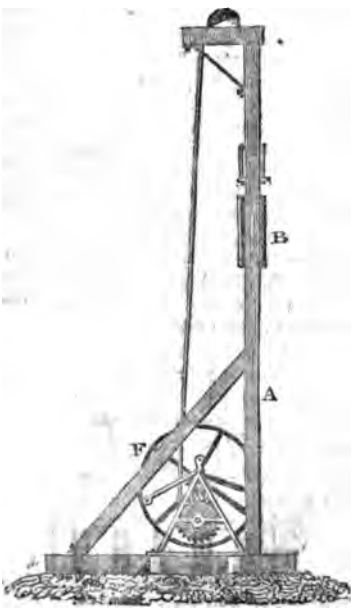
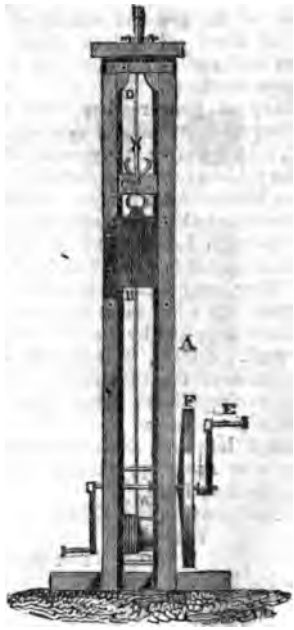


Fig. 2.



The next improvement in pile-machinery, of any consequence, was the introduction of the pincers or tongs, under several modifications; followed by the engines of Valoue and Bunce. An improvement on the last-mentioned produced the machine I now proceed to describe. Its simplicity and efficacy are such, that it has superseded all others, and is the modification now universally employed in large works where pileing is required.

Figs. 1 and 2, represent the pile-engine. AA, are the upright posts, having pieces bolted on, forming the grooves for the cast-iron ram BB to slide in. Two men working at the handles EE (fig. 2), operate upon the drum round which the rope coils. The motion of the drum is given by a pinion fixed on the axle of the fly-wheel F, and takes into a toothed-wheel placed on the axle of the drum. On this axle also is a ratchet and pall to prevent the ram falling, should the workmen leave the engine. The pincers AA and DD (figs. 3 and 4) are fixed to a piece of wood CC (same as fig. 3) called "the follower," sliding

Fig. 3

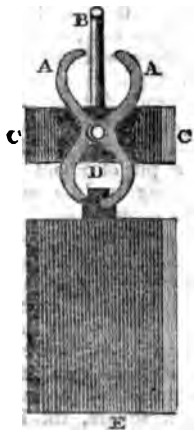
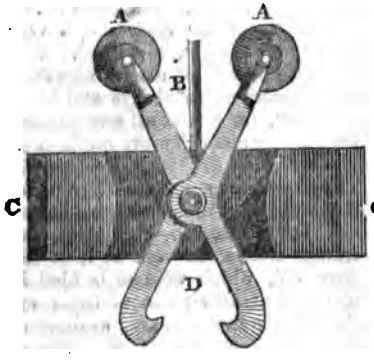


Fig. 4.

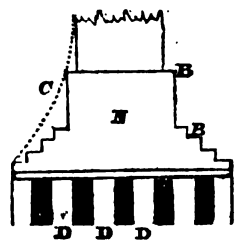


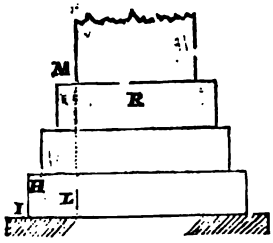
in the same grooves with the ram. The rope is fixed on to the iron BB (figs. 3 and 4) in the centre of the follower. Now, if the ram is being raised, the ends of the pincers will pass between the inclined planes D at the top of the engine (fig. 2), and by compressing the top of the tongs, will open the lower ends of them, which clip a ring on the top of the ram, and consequently liberate the weight, and allow it to fall on the head of the pile. The pall is then released from the ratchet, and the tongs and follower will slide down and again lay hold of the ring on the top of the ram (D, fig. 3). Occasionally the tongs are made with rollers (AA, fig. 4) on the ends, for them to pass with greater ease between the inclined planes.

When the tongs were first used, a strong spring was fixed upon one of the levers to keep them closed when they had taken their hold of the ram. This is now discontinued; for if made with sufficient weight of metal, they will hold with equal security.

Other machinery, together with apparatus for withdrawing the dam-pileing, will be treated of in future papers.

So much care and attention are necessary in foundations, and so many failures have arisen in those parts of a building, that an equal adjustment of the points of support, or those parts on which the weight or force is distributed—has been the means eventually of producing an investigation of curves the most proper fitted for the support of a superincumbent weight. The cone and the hollow parabola have been determined to be the best. The brick cone of St. Paul's carries the immense weight of 700 tons in the form of an elegant stone lantern, light, and cross, &c. Eddystone Light-house, the work of the celebrated Smeaton, is of the hollow parabolic contour. In this building, Mr. Smeaton says he took the idea from the lower part of the trunk of a tree, for reasons which appear obvious upon a slight consideration. A spreading base is of the greatest advantage, where, in addition to a superincumbent weight, there is a lateral thrust exerted in a direction either to overturn the resistance (the pier), or to make it slide from its original position. Piers, therefore, have spreading bases, as is shown in the following figures N and R:—





DDD are parts of the piles; BB are the off-sets, which in effect produce the form of the hollow parabolic curve C. Mr. Riou* proportions the off-sets or footings in the following manner:—"If on a bottom of good consistence the projection at bottom is one-fourth of the height, LM, from L to H (fig. R.); but when the bottom is suspicious, the third, or one-half of LM, is always allowed to project from L to I."

The circumstances which led to the rejection of pileing in a part of St. Paul's Cathedral, will form an appropriate conclusion, for the present, on the subject of foundations and pileing. They will not only lead us to admire the profound practical knowledge of our countryman, Sir C. Wren, but will be found equally of service to the tradesman and to the profession. "In the progress of the works of the foundations, the surveyor met with one unexpected difficulty; he began to lay the foundations from the west end, and had proceeded successfully through the dome to the east end, where the brick-earth bottom was very good; but as he went on to the north-east corner, which was the last, and where nothing was expected to intercept, he fell, in prosecuting the design, upon a pit, where all the pot-earth had been robbed by the potters of old time. It was no little perplexity to fall into this pit at last; he wanted but six or seven feet to complete the design, and this fell in the very angle north-east. He knew very well that under the layer of pot-earth there was no other good ground till he came to the low-water mark of the Thames, at least 40 feet lower: his artificers proposed to him to pile, which he refused: for though piles may last for ever, when always in water (otherwise London Bridge would fall), yet if they are driven through dry sand, though sometimes moist, they will rot. His endeavours were to build for eternity. He, therefore, sunk a pit of about 18 feet square, wharfing up the sand with timber, till he came 40 feet lower into water and sea-shells, when there was a firm sea-beach; which confirmed what was before asserted, that the sea had been in ages past where St. Paul's now is; he bored through this beach till he came to the original clay; being then satisfied, he began from the beach a square pier of good solid masonry 10 feet square, till he came within 15 feet of the present ground, then he turned a short arch underground to the former foundation, which was broken off by the untoward accident of the pit. Thus this north-east quoin of the choir stands very firm, and, no doubt, will stand. This narrative may be of use to others not to trust piles unless always and in all parts wet, for almost all sorts of timber under water will prove everlasting, but wet and dry will soon perish. The same cannot be said of iron, for that will decay under water: but this has been observed—in taking out cramps from stone-work at least 400 years old, which were so bedded in mortar that all air was perfectly excluded, the iron appeared as fresh as from the forge. Therefore, in cramping of stones no iron should lie within 9 inches of air, if possible, for the air is the menstruum that consumes all materials whatever. When there is a necessity to use iron* for want of stones large enough, care is to be taken to exclude sufficiently the air from it.†

(To be continued.)

* "Short Principles for the Architecture of Stone Bridges," by S. Riou, Arch., p. 50, edit. 1750.

* Iron in contact with wood, particularly on the upper side of the wedge-plate of cast-iron columns, should have lead interposed; for wood, however dry, will cause the iron to oxidize and destroy the timber in contact.—C. D.

† "Parentalia, or Memoirs of the Family of Wrens." By Stephen Wren, son of Sir C. Wren; folio, edit. 1750, p. 266.

EFFECTS OF THE LATE FROST—WATER SUPPLY, &c.

Sir,—The winter season may not inaptly be termed the plumbers' harvest, and that of the present year has been a most abundant one; I should think the bursting of pipes, &c. has hardly ever been exceeded.

Some persons have been so fortunate as to escape the inconvenience attending these accidents, while others have been deluged by two or three leaks in different parts of the house at the same time.

The mischief in the streets has been very great. In passing down Cheapside the other day, I observed *seven* different places in the paving, through which the water was bubbling up: bringing up with it, continually, portions of the cement, and also the finer particles of the gravel, which forms the bed of the road-way.* The traffic passing over these places while they were thus subjected to the action of the water, soon caused a visible sinking of the pavement.

The same remark will apply equally well to most of the other public thoroughfares of the metropolis, and a method of preventing similar effects in future is, on many accounts, a great desideratum. In the majority of these cases, the leaden supply-pipe has not burst, but has been driven out from its insertion in the iron-service main. Cannot some better mode of connexion be adopted? I have oftentimes remarked that the connexion at present employed, a common spigot and faucet joint, is not adequate to the increased pressure which the iron mains, now, in many cases advantageously used, admit of.

The New River Company's daily supply of water to the metropolis, is estimated at 13,000,000 gallons; but if the usual consumption is reduced two-thirds by the pipes being frozen, and therefore completely closed, and the company continue to endeavour to force the usual quantity of water into their mains, it is evident that a greatly increased pressure will be thrown upon those pipes that do remain open; and if this pressure be continued, something or other must give way. I well know that the pressure upon the mains, from this or some other cause, has been unusually great during the past month, and the consequent mischievous effects are plainly visible, both within doors and without.

The supply of water should be moderated, and the pressure diminished during the prevalence of severe frosts; because, even were *all* the pipes to continue *open*, the consumption of water is always considerably diminished at such periods.

The introduction of *iron* in lieu of wooden mains effected a complete revolution in the water supply; but, notwithstanding this great improvement, there still remains plenty of room for more; and if one season of the year shows the truth of this assertion more forcibly than another, it is that which we have lately encountered.

I am, Sir,
Yours respectfully,
W. BADDELEY, JUN.

February 10, 1830.

* For a description of the mode of paving there employed, see note at page 37.

MR. GRAY AND THE RAILWAY SYSTEM.

Sir,—In your comments on my railway-system, you greatly err in representing it to be my opinion at p. 333, Mag. 334, "that cog-rails are preferable to plain-rails." No part of my work or of my circular can bear such an interpretation.

You seem to think, also, that the recent experiments on the Liverpool and Manchester Railway will satisfy Mr. Gray that on the first point he is much in error, (see p. 333, Mag. 334.) On the contrary, the experiment convinces me more and more of the superiority of the cog-rail—as the same vehicle, by the additional aid of the cog-rail, would have impelled 120 tons instead of 35.

By case-hardening the surface of rails and the rim of all carriage wheels, the friction upon railways may be most materially diminished; and then by concentrating the power of the locomotive steam-engine to one specific point, by the introduction of one single line of cog-rail in the centre of the two plain rails, the simplicity of

the mechanism of this system will soon be fully illustrated.

The insertion of these few lines will greatly oblige (one of your oldest readers and correspondents)

Sir,

Yours respectfully,

THOMAS GRAY.

Nottingham,
Saturday, January 9, 1830.

Sir,—In the conclusion of your remarks on Mr. Gray's railway-system, p. 334, you evidently do Mr. Gray great injustice, as his work is founded on the practical results of Blenkinsop's patent steam-carriage railway, established at Leeds, as far back as 1811.

Mr. Gray's petitions to government in 1820, 1821, and 1822, (see his 5th edition now before me,) most clearly establish, that years before *The Scotsman* wrote, Mr. Gray was actively engaged in disseminating the important principles of his railway-system. I am much pleased that you enter with so much spirit into the railway-scheme, as I firmly believe that nothing can contribute more to our internal wealth and prosperity.

By the insertion of these few lines in your valuable Magazine, you will greatly oblige,

Your constant reader,

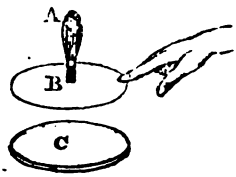
R. L. D.

Market-street, Manchester,
20th January, 1830.

[We have not disputed the priority of Mr. Gray's efforts, nor withheld from him the praise which is justly due to him on that account. All that we said was, that they had "not the good fortune" to produce so great an "impression on the public mind" as the papers subsequently published in *The Scotsman*, and this Mr. Gray himself does not deny.—ED. M. M.]

THE ELECTROPHORUS.

Sir,—Several of your correspondents have sent you descriptions of small electrical apparatus, but no one has ever mentioned the electrophorus; at which I am rather surprised, as it is much better than either the tube or the riband plan in your Magazine.



The handle A is either of glass, or of wood with a glass nut at the bottom (made black in the diagram), and is fixed to the circular plate B, made of block-tin, wired at the edge, or, if elegance is required, of polished and lackered sheet-brass. The lower plate C may be made of a variety of substances; but I give the neatest and best. Get a circular board turned of any hard wood that will not warp, about half an inch thick: then melt in a ladle several ounces of common sealing-wax, and pour it, in a liquid state, over one side of the wood, so as to cover it completely. Make the surface level by heat; a hot smoothing-iron, or a kitchen "salamander," held at a little distance over it, answers admirably. Coat the opposite side of the wood with tinfoil, and the work is complete. To put it in action, take a piece of warm flannel, and rub *con spirito*, the sealing-wax: then place upon it the tin-plate, holding it by the handle. Touch the plate with the finger (it will not do without) as represented in the sketch; take the finger off, and then raise the plate by the glass handle, and it will give out a strong spark, which may be communicated to a Leyden jar.

Many pretty experiments may be done with this little apparatus besides stunning a man's arms up to the shoulders. Being once well rubbed, it will continue in full action several hours, without being rubbed again: this is one of the most curious circumstances attending it. The description of all its powers fills upwards of four quarto columns in the "Encyclopedia Britannica." Of course, the larger the two plates are made, the greater will be the power; 9 or 10 inches in diameter is a very good size, and it is recommended that the lower plate be about one inch more in circumference than the upper. With one of these dimensions, an active operator may

charge a pint jar in one minute, so as to perforate 10 or 12 sheets of paper, &c.

Yours respectfully,
J.

P. S.—A portion of glass tube or rod, or a stick of sealing-wax, will do instead of the handle, if neatness is no object.

VELOCITY ON RAILWAYS.

Sir,—If R. C. Jun. will take the trouble to read *attentively* the papers in your Magazine on the railway-question, he will find that his observations in No. 339, have no more to do with the subject in dispute than with the dome of St. Paul's.

When a carriage is to be moved, there are three resistances to overcome: 1. that arising from the inertia of the carriage; 2. that arising from the resistance of the air; and, 3. that caused by the friction of the moving parts.

Now, the observations and calculations of Dr. Wood, as quoted by R. C., were intended to explain and measure the effects produced by the *inertia* of the body, considered abstractedly. The subject in dispute was the quantity of mechanic power equal to the resistance caused by *friction only*; to measure which, Dr. Wood's calculations were *never intended*, and are *completely inapplicable*.

R. C. will also find, I think, that his ideas were a little confused when he wrote his letter. In the beginning he seems to understand the question to be the *effects of friction*. He then "imagines" the question to be what it *manifestly is not*—enters into calculations which apply *only* to the effects of inertia—and ends by observing, "if the effects of friction be traced," &c. &c. If the effects! Why, good Mr. R. C. Jun., *they* were the *only effects* which *The Scotsman*, or his opponents, were *at all concerned about*.

As R. C. has so completely misunderstood what it was which your correspondents attempted to establish, his observations on the methods they pursued of course pass for nothing.

I am, Sir,
Respectfully yours,
Feb. 6, 1830. S. Y. (An Engineer.)

STATEMENT OF EXPERIMENTS MADE WITH WINANS' RAILWAY-WAGGONS.

We have been favoured with the following abstract of another important set of experiments, made in the latter end of January, by Mr. Vignoles, engineer, to ascertain the exact amount of friction of railway-waggons, made on the plan of Mr. Winans', as described in our 328th and 333rd numbers.

We are informed that Winans' small waggons were those used by Mr. Vignoles when he made his experiments on the power of "The Novelty," as stated in Number 339; and that Mr. Vignoles assumed from the state of the rails on that occasion, that the rolling and axle-friction was about six pounds to the ton. But in this estimate he did not include the lateral friction, and made no allowance for the retardation arising from so long a train of waggons not connected together (as we understand they will be in practice) by bent springs to prevent shocks, &c.

The comparison of these two sets of experiments we consider highly interesting, and eminently deserving the attention of scientific men. From a rough calculation of our own, we are inclined to think that the total expense of fuel, wear and tear of locomotive engines and waggons, will not exceed 1-3rd of a penny per ton nett per mile.—Ed. M. M.

Abstract of Experiments.

The mean of a series of experiments made with one of Winans' 20-inch wheel waggons, without springs, weighing about 12 or 13 cwt., and loaded with 2½ tons, shows that the waggon, after being only just put into motion on the foot of the inclined plane at Whiston, ran over 932·59 feet in 232 seconds, the perpendicular fall in which length was 24½ inches. Several of the individual experiments agreed within a fraction of the above mean.

$$\text{Now } \frac{931\cdot59}{2\cdot06} = 452$$

which shows that the 20-inch wheel-waggons would roll self-moving on an incline of 1 in 452, or 11 ft. 8½ in a mile:

$$\text{and } \frac{2240 \text{ lbs. in a ton,}}{452} = 4\cdot95 \text{ lbs.}$$

friction in a ton, or a force of 5 lbs. would move a ton. The above inclined plane fell 18 inches in the first 200 feet; 6 inches in the next 500 feet, and ⅜ of an inch the succeeding 200 feet; the remainder of the distance being quite level. The initial velocity was 2 feet per second, the maximum acquired velocity 7 feet, and the terminal velocity 1 foot per second.

The rails in these experiments were free from absolute dirt, though not perfectly clean; they were somewhat oxidized, and on the whole, may be considered as having been in the state they will be practically found in when the road is travelled over by trains of waggons drawn or propelled by locomotive steam-engines—no horses working on the railway.

On a succeeding day the same waggons, similarly loaded, were tried on the two-mile level at Rainhill. Upon this occasion, the rails were in far superior order, and may be said to have been perfectly clean, and free from every particle of dirt or impurity. A weight of 10¾lbs. freely suspended over a 2-inch pulley, kept up the momentum of the waggon (when once put in motion) at the rate of about 2 miles per hour. The exact weight of the waggon and load was 62½ cwt. or 7000 lbs.; therefore as 7000:2240:: 10·75:3·44lbs. friction in a ton, under the most favourable circumstances for small wheels: but as in the practical use of such wheels they will always be to some extent retarded by minute impediments which will not affect large wheels, it will be more proper to state the total rolling and axle-friction of Winans' 20-inch wheel waggons at these velocities as not exceeding 5 lbs. in the ton. It is clear, from the experiments of Coulomb and others, that the friction is not increased by an increase of velocity; but it is probable that at high speed, and with a long train of waggons, especially if they are without springs, oscillation will take place to a great extent, and cause a rubbing, or lateral friction, of several lbs. in the ton. This lateral friction is also increased by too much conicality upon the rim of the wheel, and is applicable to all descriptions of railway-waggons, though in what proportion as regards the diameter of wheels and axles, flat or conical rims, common fixed axles, and those on Winans' principle, remains to be determined by future experiments.

On the same day, with the small wheels, other experiments were made with Winans' 3-feet wheel-waggons fitted up in the best manner, but without springs under the body of the waggon. The results on the inclined plane showed that the waggon being only just put into motion, passed over a space of 824·67 feet in 275 seconds, the perpendicular fall in which length was only 11 inches, or 0·92 feet: of this fall, 7½ inches occurred in the first 200 feet—3 inches in the next 550 feet—and only half an inch in the last 75 feet. The initial velocity was 2 feet per second; the maximum acquired velocity 4½ feet per second; and the terminal velocity 8 inches per second.

The same waggon on the perfectly clean and level railway, and weighing with its load 80½ cwt., required only 9¾ lbs. to keep up the momentum (when put in motion) at the rate of 2 miles per hour.

The result, therefore, by the inclined plane experiments, or

$$\frac{824{\cdot}67}{0{\cdot}92}=896,$$ shows that the 3-feet wheel-waggons will roll self-acting on an inclination of 1 in 896, or 5 ft. 10¾ in. in a mile; and,

$$2240 \text{ lbs. in a ton} \frac{\quad}{896}=2{\cdot}5 \text{ lbs. friction}$$ in a ton.

And by the experiments on the level—as, 80½ cwt. or 90160 lbs.:2240 ::9·75:2·42 lbs. friction in a ton.

The near coincidence between the results of the two sets of experiments, shows that the small inequalities on the rails of the inclined plane, which affected the small wheels, produced little or no sensible effect on the larger wheels.

On the whole, it appears that the total rolling and axle-friction of Winans' 3-feet wheel-waggons, on clean rails, and at the velocities tried, is about 2½ lbs. in the ton. The former remarks made on the oscillation and lateral friction will apply here, considering, as before, that the rolling and

axle-friction is not increased by an increase of velocity.

It should be remarked that during the experiments, the waggons were tried with both light and heavy loads; and when gravity was the moving power, the waggons, with all weights, constantly passed over the same length in the same times. And former experiments have even shown, that a pair of wheels connected simply with an axle-tree, passed over equal spaces in equal times with a loaded waggon; thus clearly proving that the friction is directly as the load.

In conclusion, it ought to be stated that no opinion is here meant to be given as the validity of Winans' patent, which is said to clash with one taken out by Mr. Brandreth of Liverpool.

PLAN FOR DISPENSING WITH THE AIR-PUMP IN THE CONDENSING STEAM-ENGINE.

Sir,—With a view to unfetter the condensing steam-engine by dispensing with the use of the air-pump, and, consequently, bringing the said engine to its natural perfection, the following project is proposed. Let the condenser be equal to the cylinder in area, and about 33 feet in length. A loose bottom, governable by a lever or pulleys, must close the under-end of the condenser at the starting of the engine. The injection-water will then accumulate until it ascends to about 31 or 32 feet (mineral water), when it will begin to preponderate, and the loose bottom will drop from the flange, and the condenser become a self-clearing condenser, effecting a pressure of 15lbs. per square inch at the top, acting on each side the piston alternately. The additional power and simplicity of an engine of the above construction are too obvious to require explanation. However, it may be added, that the water in the condenser is suspended as the mercury in the barometer, and its whole weight thus hanging, counteracts the pressure of the cylinder, and hence effects a self-clearing, and produces in the cylinder an uninterrupted vacuumnal power of about 15lbs. per square inch on each side the piston, as before stated. When the delivery-drift of an engine-shaft is 5 or 6 fathoms below the surface, the situation is most favourable for the above construction.

I am, Sir,
Your most obedient servant,
WILLIAM THIRLWALL.
Shilbottle, near Alnwick,
Jan. 13, 1830.

COAL-TAR.

Sir—As from the great increase of gas-works, coal-tar is now produced so abundantly, it may be interesting to your readers to know that a most useful purpose to which it may be applied, has lately been discovered by a scientific person of my acquaintance, who has a house covered with red tiles, which were constantly requiring repair, either from the effects of frost, which shelled them off and gradually destroyed them, or from the wind, which blew them off the roof. He has covered them with two coats only of *common coal-tar*, laid on with a brush like paint, without the addition of any other substance.

The first application was nearly absorbed by the tiles; the second formed a dark shining coat over the whole, resembling sheet-iron, and in a very few days became apparently as hard. The roof has since required no repair, nor has a single tile been affected by the frost; it appears to form one solid compact body, and rings, when struck, as if it were so. I doubt not the same effect would be produced on all roofing, covered either with tiles, Welch or other slates, or with the Oxfordshire Stonespild slates, all of which are liable, more or less, to injury from frost or wind.

My house is covered with blue slates, and owing to the roof being too steep they are often blown off. As soon as the weather allows it, I shall certainly try the application.

I am, Sir,
Your constant reader,
AN AMATEUR MECHANIC.

COLZA OIL.

Colza Oil, or *Huile de Colza*, is extracted from the grain of the Brassica Arvensis, or Campestris, a species of

cabbage. The Colza is very much cultivated throughout France and the Netherlands, on account of its various and useful qualities. When the seed is ripe, which generally happens in the month of July of the following year, the plant is cut, tied in small bundles, and put under a shed, or any covered and airy place, to dry. The grain is beaten out, and cleaned in the manner commonly used for the extraction of wheat or other grain, and is then treated for the oil. As the oil comes from the press it may be directly used, with potash, for the fabrication of soft soap; but if intended for burning, it is necessary that it should undergo another preparation, in order to separate from it its mucilage and the colouring matter, which prevents its ready combustion. We are indebted to M. Thenard for the method of purification. It consists in mixing two parts of sulphuric acid(concentrated)with a hundred parts of *oil*, which are to be well stirred together until the acid combines with the mucilage and colouring matter, which are gradually precipitated in flakes of a blackish green colour, after which a quantity of water equal to double that of the oil is added; the whole is then freely agitated with the intention of depriving the oil of the free acid; it is then left to settle for the space of ten days, at the end of which time the oil, which is upon the surface of the water, is decanted into tubs, in the bottom of which are holes filled with cotton, through which the oil is allowed to filter, when it is perfectly pure. This method of purification is applicable to all seed oils. The oil of Colza thus prepared, has very little odour, is of a yellow colour, and has a sweetish taste. It is not very soluble in alcohol. When congealed it crystallizes in small needles diverging from a centre.—*Franklin Journal.*

MINOR CORRESPONDENCE.

The Gilman Controversy.—Sir, I have felt a considerable interest in the discussion between Mr. William Gilman and "A Practical Engineer," and I may add yourself. The subject involves matters of considerable importance; and if Mr. Gilman has it in his power to substantiate his statements as contained in Nos. 330 and 331 of the "Mechanic's Magazine," I think he has displayed exceedingly bad taste in not doing it, and in not proceeding (to use your emphatic language) *to grapple at once with the facts of the case.* Notwithstanding the want of courtesy in the individual who signs himself "A Practical Engineer," the public have a right to demand explanations of the apparatus laid *before* them, called *Gilman's* generator, and of the statements with which he ushered it into the world, and I must say that the witticisms contained in his address to you of last week, is a meagre substitute for the required explanations.

I shall be obliged by your inserting these remarks in your Magazine; and should Mr. Gilman not treat the subject in the way it merits, I shall feel it my duty to make some severe observations upon his conduct.

I am, &c.
PETER PINDAR.

Manchester, Feb. 9, 1830.

Jackson's Patent Studs.—Sir, In consequence of the notice you have taken of R. W.'s communication to you respecting these studs, in the last number of your valuable work, I feel it necessary to say that it would be useless for any person to purchase any of the studs for the purpose of fixing them in a boot or shoe, which would be almost impracticable without the aid of the machinery and implements used for that purpose at the manufactory in Giltspur-street; where any quantity of boots or shoes may be studded on very reasonable terms—a handsome allowance being made to any of the trade encouraging the invention, which is daily advancing in the public estimation by the increased demand for the studded boots and shoes.

R. W. greatly overrates the expense of carriage of a pair of shoes or boots, which might even be sent from the Land's-end to London, and back, for less than he mentions; and if many were sent in one package, the expense of each would be but trifling.

No person, but the proprietor of the patent for the original invention of the studs, or his appointee, can apply them in England or Wales; and any improvement thereof will not excuse the infringement of the patent-right for the invention.

I am, Sir,
Your very obedient servant,
G. JACKSON.

INTERIM NOTICES.

With our next number, which will complete vol. xii. there will be published a supplement, containing titles, preface, and index; and a beautiful portrait on steel of Thomas Squire, Esq. of Epping.

We have been obliged, from want of room, to defer till next week the conclusion of the article on the "Dangerous Consequences of Removing the Old London Bridge;" but we insert two letters we have been favoured with on the subject, that will probably compensate for any disappointment our readers may feel at the postponement of our own observations—the letter from Mr. Thoundike in particular, which contains some documentary evidence of great originality and importance.

S. V.—As soon as we can find room; very likely next week.

Communications received from Mr. Harrison—Mr. Saul—Exulpa—G. S.—Tiler—Mr. Deas.—M. D.—Metrosynesis—Mr. Gilbert, Jun.—V. V.—Mr. John Smith—H. T.—Mechanicus—J. G. N.—A Promoter of Genius.

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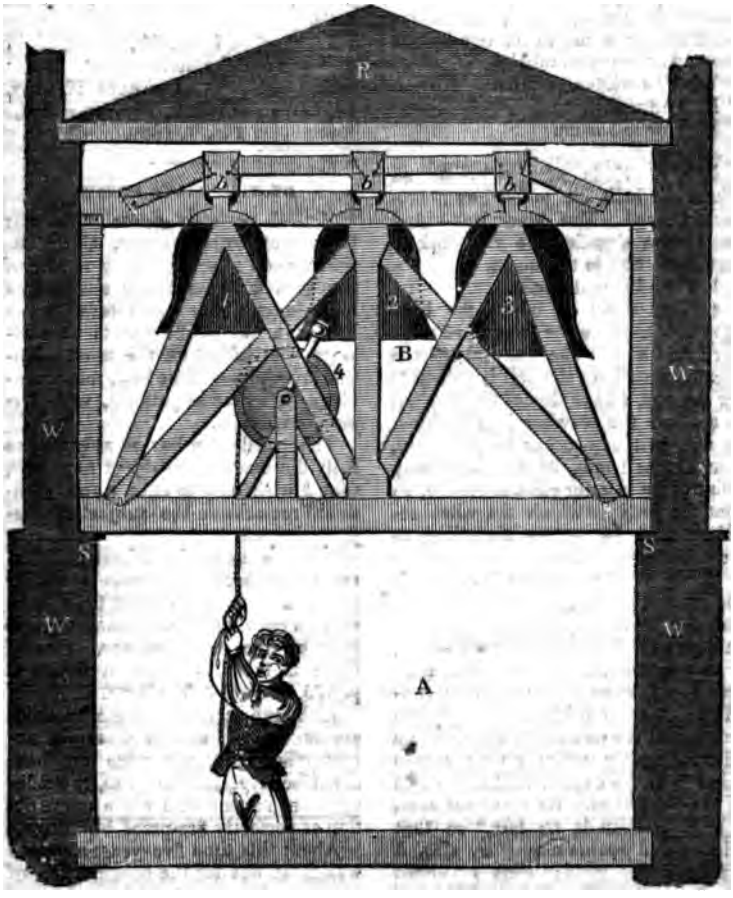
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 342.] SATURDAY, FEBRUARY 27, 1830. [Price 3*d*.

"We have but to cast our eyes around us, and we will find that every skilful operation we perform, or which is performed by others, has at some time or other depended for its success on a close observation of the laws of nature and the properties of matter."—STORCH.

DESIGN OF A BELL-TOWER WITH DRURY'S IMPROVEMENTS.



DESIGN OF A BELL-TOWER WITH DRURY'S IMPROVEMENTS.

Sir,—I have been much interested by the notice taken in your laudable work of the new improvements devised in the mode of hanging and ringing church-bells in peal; and should be wanting to my own entire approbation of the whole scheme, were I to withhold any idea which *my* best judgment may suggest for the final perfection of so valuable a project as that of Mr. Drury's, so fairly explained by Mr. William Baddeley, Jun. in your 338th Number.

And as it does not appear that the improvements proposed have yet been practically accomplished, permit me to anticipate a design for one by the accompanying general sketch.

W. The walls of a tower.

R. The roof.

B. The bell-room.

A. The ringing-room.

b, *b*, *b*. Ends of the beams on which the bells are to be hung, properly trussed. The black line round each beam signifies the iron-work to fasten the bell to the beam.

1, 2, 3. Intimate bells.

4. The wheel on which the bell-rope acts to move the tongue, or clapper; and as this one example of the means of striking the bell is sufficient for the rest, I have thought it best not to confuse the drawing by repetition. It will instantly occur to reflection, that the bell may be struck on any point of its interior circumference, so that the posts on which the wheel revolves may be set up according as circumstances require.

Being totally unacquainted with the present system, I should not have had the presumption to touch on the subject as it has hitherto stood—but, a new contrivance must be equally new to all, even to the original contriver; this sets aside all past knowledge, and the new may be perhaps as advantageously taken up by a *new mind* as by the experienced operatives of the old school. Be that as it may, "a proposition is no law," so that science and genius may "try all and hold fast the good:" thus I submit my "mite" to the cause, wishing it *may be* of some small service to a matter of so much general importance.

I propose the whole timber-framing to be on all sides within the bell-room, only close to walls, but not worked into them, except the principal bearers. The frame complete should bear all round on the wall at the bottom as at S, so that all the framing represented by the example is to be understood to be close to the wall that would be on *this* side of it, and bear all along as it does at S. I should advise the whole bell-room to be covered in the interior with oak boarding, and the ceiling also. It may be requisite to repeat the supporting framing, intermediate, in some proper degree, according to the weight of the bells.

I am, Sir,
Your obedient servant,
CHARLES HAYTER.

16, *Cirencester-place*, *Fitzroy-square*,
Feb. 1, 1830.

ON FIRE-PROOF HOUSES.

Sir,—I perfectly agree with your intelligent correspondent, C. D. S., that we can at present form no idea of the great and important advantages to business which would result if the houses in our public streets were always constructed on the most scientific principles—of the best, most durable, and, as far as possible, with *fire-proof* materials.

This gentleman has so ably and so fully discussed this subject at p. 365, that I wish only to offer a few additional remarks on the subject of *fire-proof* houses.

Numberless methods have at different times been proposed, to render wood and other combustible substances capable of withstanding and resisting the effects of fire. One of these methods is given in detail at p. 175, of your 6th volume.

Although several of these methods are ingenious, and to a certain extent efficacious, yet none of them are, I believe, sufficiently so, to render these substances fit for the construction of perfectly fire-proof buildings.

About this time five years a patent was taken out for the construction of fire-proof houses by Mr. Farrow, of Great Tower-street. His method consists in using joists of wrought iron

These joists have a flange on each side, upon which are laid, from joist to joist, a series of flat stones, of such a thickness as to lie flush with the upper edge of the joist, thus forming a perfectly level floor of stone, with intervening lines of iron; and it may either be used in this state, or a regular boarded-floor may be placed upon it.

There are several advantages attending this mode of building, among which, increased strength and durability are not the least important. There is also considerable space gained; for a floor constructed in this way occupies scarcely one-fourth the depth of a wooden one. Nor is it to the *floors* only that Mr. Farrow proposes to apply this mode of construction, the roof is finished in a similar way; with the addition of a coat of mastic.

I some time since inspected a room which Mr. Farrow fitted up on this plan in Mark-lane; and have no hesitation in saying, that I consider the fire-proof quality is fully obtained by it.

But, although Mr. Farrow's method most effectually answers its intended purpose, yet considerable approaches may be made towards obtaining the same desirable object, by a judicious distribution of iron, stone, and bricks, in the more usual mode of building. Many of the modern *public* edifices have been constructed on the fire-proof principle, by the introduction of sometimes *wrought*, but more frequently *cast*-iron beams and rafters. Notwithstanding this, however, the application of a similar safeguard to *private* houses—such as may more appropriately be designated by the term domestic architecture—has yet made very little progress: and it was with no ordinary degree of pleasure that I noticed the commencement of that application which I briefly described in your 324th Number. Perfection is not to be jumped upon all at once in any of the arts of life; I am, therefore, well-pleased to see a beginning, knowing that progressive improvement will almost inevitably follow.

To form an estimate of the value of this beginning, that is, of the adoption of *cast-iron story-posts and bretsummers, let us consider* what takes place when a fire breaks out in a house furnished with wooden story-posts and brestsummers. These serve to assist and increase the quantity and power of the flames by their combustion; and when that has proceeded to a certain extent, they give way under the pressure of the superincumbent weight, and the building falls in ruin to the ground. On the other hand, brestsummers and supports of iron are not only themselves incombustible —but, in the event of a fire, the quantity of caloric which the mass of metal they contain will greedily absorb, will, according to the principles laid down by Sir Humphrey Davy, tend materially to damp the energy of the fire, and check instead of augmenting the fury of the flames. Not being combustible, it will not be necessary to direct a stream of water upon them, and the brick-wall and wide stone-coping above, will prevent any descending water from falling upon them. Besides which, I doubt much whether any fire they are likely to encounter will be sufficient to heat them to such a degree as to cause them to crack, should water by any means be thrown upon them. In this light, then, I consider the substitution of *metal* for *timber* in these parts of a house the first step towards securing them from *two* of their most destructive ravagers—fire and the dry-rot. The destruction of several princely mansions by fire, within the last month, gives additional interest to my present subject; and I cannot conclude this article better than by quoting the following judicious remarks from "The Tocsin:"*—

"Many persons unacquainted with building affairs, imagine, that to make a house fire-proof will require all the materials to be made of metal, stone, or brick-work; but I can assure them this is not necessary. A judicious arrangement of these materials will be only required, and that may be done without any detriment to the building, either in its appearance, or in overloading the walls. A stone-staircase forms an excellent

* "The Tocsin, or, A Review of the London Police Establishments, with Hints for their Improvement, and for the Prevention of Calamitous Fires," &c. By Thos. B. W. Dudley, Esq.

escape from fire, if the whole of the masonry be fixed in brick-work, otherwise no dependence can be placed upon its utility. All partitions should be made of brick-work, and the main beams, joists, &c. of each floor should be made of cast-iron; a house thus framed we will call the skeleton, and if every apartment were then filled with combustibles, and set light to, every part would remain firm, and retain its original position. After this you may batten your external walls with lath and plaster to keep out the damp; and plaster your ceiling, and run the cornice; the internal wall or partitions may be plastered only; fix your dados, lay down your floor-boards, fix the skirting-boards, architraves, doors, &c. Now, we will suppose a window-curtain to take fire, what harm could it do more than destroy it, and disfigure the painting? It could not set fire to the floor above, because the flame could not reach it, and the joists are made of iron. Who ever heard of a fire commencing with a door, or a floor which was closely fitted together? As fire and flame ascend, it is difficult to make wood burn in a horizontal position, therefore there is no danger to be apprehended from a floor burning when laid on iron-joists. It is therefore evident, if this plan were adopted, no fires of any magnitude could take place, and the lives and property of the public and individuals would be securely protected."

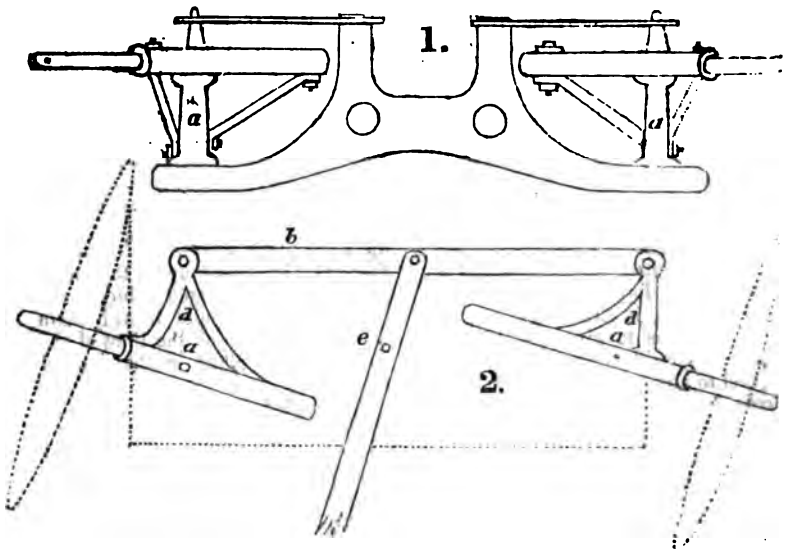
Notwithstanding the length to which this communication has extended, I find there are still several points which remain untouched; I shall, therefore, return to the subject at an early opportunity. In the mean time I remain,

Yours respectfully,

WM. BADDELEY. Jun.

Feb. 8, 1830.

KNOWLES'S AXLE-TREES.



The above engravings represent a very ingenious invention, for which a *patent* was taken out last summer, *but the* specification of which has *only just* been enrolled.

This invention is intended to improve the construction of carriages so as to afford greater facility in the operation of turning, and it consists in an arrangement by which each wheel is

permitted to turn, or make an angle with the side of the carriage, which is effected by separating the axle in the middle, or rather making a short axle for each wheel, which are attached to a vertical axis represented by *a*, figs. 1 and 2. One end of this vertical axis turns in a socket fixed in a cross-beam, which occupies the place of the axle-bed of carriages of the usual construction, and to the middle of this cross-beam is fixed a piece of strong framing, whose ends are curved outwards from the cross-beam to receive the other ends of the vertical axis, as represented by fig. 1.

A plan of this arrangement is represented by fig. 2, showing the method of preserving the two wheels, at the same angle, with respect to the sides of the carriage. *b* is a connecting-bar, uniting the two wheels through the medium of the projecting pieces *dd*, and with this bar is connected the pole turning on the centre *c*. By this ingenious parallel motion the wheels are made to assume the position most advantageous for turning with very little exertion on the part of the horses, as the friction is very considerably diminished by the reduction of the rubbing parts to mere pivots.

The patentee details in the specification the methods of applying the improved axles to carriages, either with or without springs, but the above principle is adopted in both cases, and it may be varied to suit the construction of the carriage for which it is intended. The advantages of this arrangement will be evident, when it is recollected that the central pivot on which the axles of the fore-wheels of carriages usually turn, is situated so far from the wheel as to give a leverage requiring considerable room, for one wheel to advance and the other to recede in the operation of turning. In axles of the present construction the fulcrum is situated within four inches of the nave, and hence the wheel locks to its full extent without receding, or advancing, more than a few inches. The following is the patentee's own statement of the principal advantages which these axles offer:—

"This invention wholly supersedes the necessity for a perch, and enables the body of the carriage to swing independently of the axle-trees, and approach within a foot of the ground at its full width, besides the advantage of having high wheels, without danger of touching the body, however short the carriage is turned. It also reduces the weight of a carriage without lessening its strength. Another advantage is its having the axle-tree fast to the spring within 3¼ inches of the nave; the unpleasant check to the wheel and the pole, which arises from obstacles in the road, is entirely removed. In addition to these may be mentioned the capability of the carriage going on three wheels, by a proper adjustment of the load, in case of an accident to the fourth."

SEPTENARY SYSTEM.

Sir,—In vol. ix. p. 437, I ventured to express a doubt whether "F" was correct in stating that the curves produced by the motion which he proposed, and which is described by fig. 2, p. 436, were epicycloids. The epicycloids to which I supposed he referred, were those produced by a circle rolling upon or within a circle. But as mathematicians have made use of that term, with an adjective prefixed to denote various effects produced by other curves rolling upon curves, and in consequence of the new light thrown upon the Septenary system by the discovery that in every case of motion the lever of the cusps upon one plane always roll upon the lines of the cusps upon the other plane, I have considered it due to your readers that I should furnish them with a description of the lines of the cusps on each plane in that class of motion.

Although "F" said, "I will demonstrate (if necessary) that the curve engendered is an epicycloid," I think I may be still permitted to doubt whether he had any conception of the forms of the lines of the cusps, which by rolling upon one another would produce that motion.

Fig. 1, is the moveable plane. *a* is the pole, *bc* is the right line, *df* is an arc, of which *a* is the centre, and *bced* is the line of the cusps.

Fig. 1.

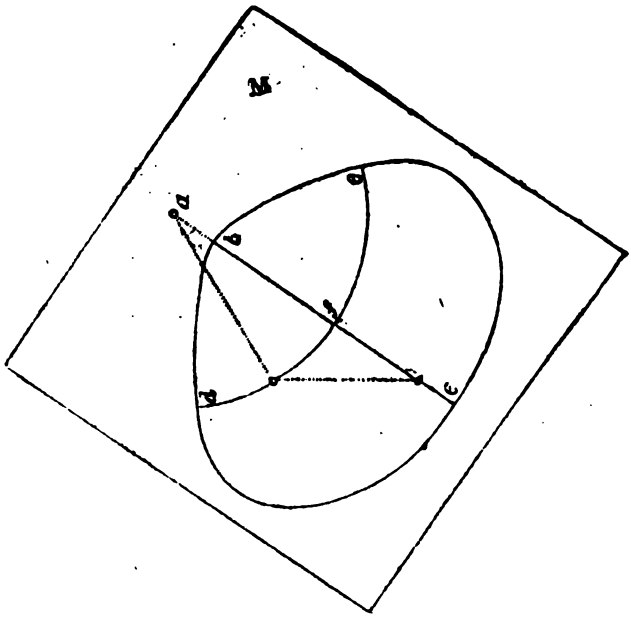


Fig. 2, is the fixed plane. A and B are fixed poles, ACB and ABD are the lines of the cusps. The circle, of which A is the centre, is described by the pole *a* upon the moveable plane; while the pole A on the fixed plane describes the arc *dfe* twice on the moveable plane.

Fig. 3, shows the line of the cusps on the moveable plane M rolling around the lines of the cusps on the fixed plane F.

Fig. 2.

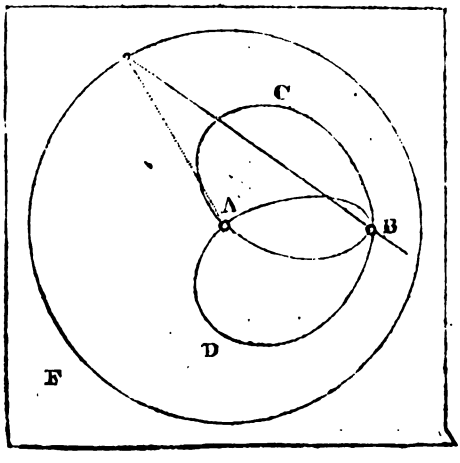
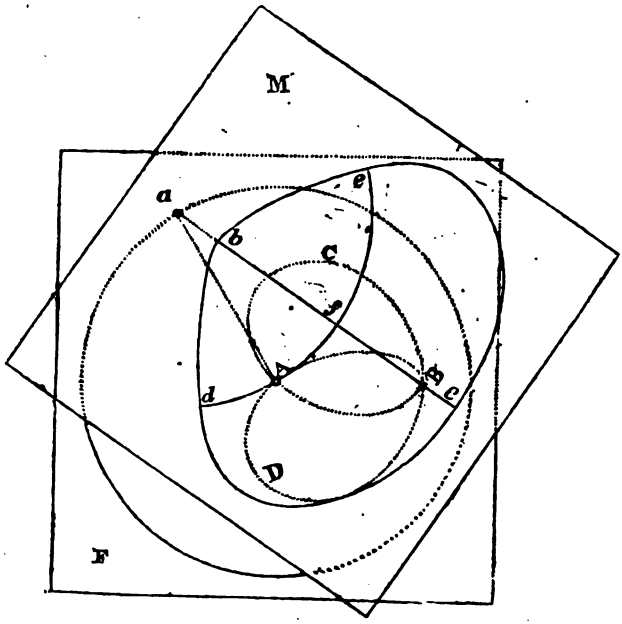


Fig. 3.



Although the lines of the cusps on the plane M is very different from the lines of the cusps on the plane F, it is, I think, manifest, that their circumferences are equal; but the proportions of the areas they respectively enclose is submitted to the consideration of your mathematical friends.

If the pole B had been fixed on the circumference of the circle, (see fig. 2) the line of the cusps on each plane would have been a circle. But if B were placed beyond the circumference of the circle, each plane would then have two infinite lines of the cusps. On the moveable plane M the two lines of the cusps would in that case have one assymptote, and on the fixed plane F the lines of the cusps will have two assymptotes crossing each other.

These extraordinary variations in the lines of the cusps are produced by the most trifling variations in the position of the pole B. When it is the least possible distance within the circle, we have the finite, but, in some measure, complex forms for the lines of the cusps. When B is in the circumference of the circle, the lines of the cusps are the most simple; but when placed the least distance beyond the circle, the transition is as extraordinary, being nothing less than passing instantaneously from finite to infinite. While, however, there is such a difference in the lines of the cusps, their epicycloids are all finite.

These are results which it is obvious could not be conceived; neither could it be known without investigation that such complex and infinite curves rolling upon each other should contain such simple motions and finite effects.

Ever since I first discovered that in a great many cases a plane in motion contained one or more lines of the cusps, I have deemed a knowledge of them of the first importance in order to have a clear idea of any particular case; but I did not think that I should have discovered so simple a rule for ascertaining the figures of those lines in every case in the Septenary system; nor did I anticipate

that the lines of the cusps on each plane in any case roll upon the lines of the cusps on the other plane.

I have another paper on the radius of curvature at the cusps of cycloids, and which I intend for the "Mechanics' Magazine;" but as I have to fill up some references to figures in papers sent but not yet published, I must retain it till after those appear in your pages.

I am, Sir,
Yours, &c.
JOSEPH JOPLING.

DESCRIPTION OF A TWO-LEGGED CAT.

Sir,—Although articles on natural history do not exactly accord with the plan of your work, yet as I have known a few instances wherein similar subjects have found a place in your pages, I have, with this impression, taken the liberty of sending you a neat and correct drawing of a cat belonging to Mr. Doubleday, of Epping, which is by nature completely deficient of the most essential members that can entitle her to the appellation of a good mouser.

The mother of this cat was of the tortoise-shell kind, and at the time when the latter was kittened she brought forth five others which were, in every respect, perfectly formed,

but, by some mishap or other, in apportioning of legs poor Puss got only two! Nevertheless, she is perfectly happy; for having a good appetite, besides being very healthy, and carefully fed, her jet-black coat is as sleek and fine as the finest of her congeners.

This cat is now about six years old: she is very active, and can jump upon a table, or other projection, three or four feet high. Her walk is singularly undulating, and when she is in a hurry she leaps like a frog.

In general, young kittens are arrant teasers to her, whereas at other times she is very fond of them. In her nightly rambles her call, in such cases, is more sharp and piercing than that of other cats: she has had no kittens. She is remarkably cleanly, and when she has occasion to wash her face, she first licks the upper side of one of her feet, and then rubs the former against that part of the latter. She is not fond of being taken up and nursed, though very partial to those of the family who notice her, but at the same time is very shy before strangers.

She frequently sits in the same position as shown in the drawing, especially when waiting for something to be given her; in this case, what with her large yellow eyes, and black coat, she presents a singular and rather ludicrous appearance.

Although destitute of claws, she can catch a mouse as well as the best of her kind, but in the act of shifting her hold, she is very apt to let it go again.

The scapulæ, or blade-bones, are small, and the rudiments of legs may be felt under the skin; small tassels of hair occupy the places where the latter members usually protrude.

Sometimes when she sits in an upright position, her tail is extended for the purpose of additional support; in that case, she reminds one of that singular animal of Notasia, the kangaroo.

On the whole, this cat is considered by all who have seen her, a great natural curiosity.

The drawing was taken by Miss Louisa Vully, a young lady from Paris, whilst on a visit here last summer. Yours respectfully,

Epping, Feb. 1. A NATURALIST.

DANGEROUS EFFECTS OF THE REMOVAL OF THE OLD LONDON BRIDGE.

(Concluded from p. 444.)

Of this we are sure, that had a *new bridge, with sluice gates*, been the thing proposed, the promoters of the measure must have taken some other parliamentary ground than that which now figures in the preamble to their Act of Parliament. They could not have admitted that sluice-gates were necessary to preserve a certain beneficial effect produced by the old bridge, and, in the same breath, have denounced that bridge as "productive only of "danger and destruction;" they must have frankly acknowledged, that though it may render the navigation "*under it*" hazardous to the unskilful and careless, it greatly improves the navigation of all that part of the river *above it*; and having granted so much, they might have been puzzled to assign a good reason why a structure which produces, on the whole, more benefit than injury to "the navigation," (that being always the great object of concern—the *professed* object, at least), should be doomed to destruction.*

An ordinary pretext for taking down bridges is their want of stability; but, in the present instance, there was nothing of the kind to allege. From the examinations which took place in 1759, when the large arch was made, and again, in 1821, when the project of the new bridge was brought forward, it clearly appeared that the old structure was in a perfectly firm and stable condition. Had there been even the slightest ground for pretending that there was a chance of a tumble down, from natural decay, we may rest assured, that so excellent a circumstance would not have been forgotten in the preamble to the Act for the demolition of the bridge.

As little could any handle have been made of the state of the old bridge as a public thoroughfare. It is not, like most old bridges, either crooked or narrow, but as straight as either Westminster, Waterloo, Blackfriars, or Southwark Bridges, and *wider than any of them*.

The *approaches* to the road are bad; but though this might have furnished a

* We have seen it stated ("Phil. Mag." vol. ix. p. 33.) that "in the last century, Parliament passed an Act to *compel* the corporation to *open* some of the arches, and to increase *the fall*, which the present Act complains of." This, if true, may serve to show that it is not always from juster or more enlightened views that people depart from "the wisdom of their ancestors."

reason why these approaches should be improved, it could form no reason for taking down the bridge itself.

If, then, the promoters of a new bridge could neither have shown that the old bridge was in a state of decay, nor have urged that it was inadequate to the traffic over it; and if they had, at the same time, admitted that the losses occasioned by the fall under the bridge were more than compensated by the advantages arising from the head of water maintained above bridge, what pretext could they have left for calling on the legislature to sanction its demolition? Evidently none whatever. Foreseeing well the hopeless predicament in which such an admission would have left them, they carefully avoided touching at all on the state of the river above bridge, or adverting to any thing which, like the utility of sluice-gates, might point attention in that direction; they dwelt only on the dangers and disasters of the "great fall" at the bridge, as they were pleased to style a rapid, such as an American would laugh at, and in the teeth of their own witnesses, exaggerated these dangers and disasters most abominably: shut their eyes, in short, to every thing in favour of the bridge, while they applied a magnifying-glass, of prodigious powers, to the smallest particle of evidence adduced against it. The loss of one drunken waterman and one crazy coal-barge per annum, formed *the whole* of the notable case which served in this instance to procure an Act of Parliament, which has put in jeopardy the subsistence and the fortunes of thousands.

That a project, resting on such shallow and delusive grounds, should have succeeded so well, is, of course, only to be accounted for on the supposition of the existence of a state of the public mind exceedingly favourable to it. The project of a new bridge was, it must be confessed, a popular one. There was almost as great a readiness in most people to be deceived on the subject, as on the part of the projectors to deceive them. The recent erection, on every hand, of new bridges, greatly superior in architectural beauty to the old London, had combined with the natural fondness of all multitudes for novelty and embellishment, to excite a spirit of emulation in the *City Proper* part of the metropolis which disdained to descend to such vulgar considerations as mere prudence and economy suggested.

It is due to the Corporation of London *to state*, that they were far from participating in the feelings of their constituents in this matter. They opposed the measure of a new bridge most resolutely, through many stages of its progress, and only gave way at last, when the influence of Government united with popular opinion to make resistance unavailing.

Well; the people, and the Government, and the jobbers have had their way, and it is to be hoped that they will at length suffer the wise, and the reflecting, and the disinterested to have a little of theirs. The taste for magnificence has had ample indulgence, and it is but reasonable, that some care should now be had for those who are liable to be sufferers by the event. Much as the erection of the new bridge and the formation of the approaches to it may cost the public, that cost, we apprehend, will be found but trifling, compared with the amount of permanent damage which will be sustained by the trade and navigation of the upper part of the Thames, should the old bridge be taken down, and no steps be taken to avert those effects, which, it has been shown, must naturally result from such an alteration in the channel of the river. The talk will not then be of the million or couple of millions which this splendid improvement cost; the answer to enquirers will be, that it *cost half the trade of the metropolis*. In a future paper we shall enter into a full examination of the means of averting so ruinous a result.

REPLY OF MR. GILMAN TO MR. SYNGLEMAN.

Mr. Editor,—In my last communication, I stated it to be my intention to reply to the "Practical Engineer's" analysis, contained in your 85th number, so soon as opportunity offered: hitherto, however, uncontrolable circumstances have interposed, and prevented me; but I hope to be prepared for the next or following number. In the mean time, please to allow me a small space in the Magazine for a word or two to Mr. J. Syngleman.

I am exceedingly obliged to him for having introduced Mr. Hall's patent to the more particular attention of your subscribers, as it happens to be the *only one* with which I am acquainted, either directly or indirectly, among those patents which the "Practical Engineer" charges me with pirating, and the knowledge of which I derived from the same source as J. Syngleman, "The Register of Arts."

Had Mr. Syngleman, however, been *really* actuated by the *good* "*old English principle*" he professes to be, and *absolutely* "*wished to see fair play*," I apprehend he would not have been so sparing of *his labour*, but would have taken a little "*more trouble*," and *transcribed* the remainder of the paragraphs which *describe* the *real object* of the patent in question, in which case I should not have had occasion to trouble you with any remark.

I will now take leave to state, most distinctly, that this patent neither suggested the *principle* nor *influenced* the arrangement of the generator described in my narrative in the *smallest degree*. But admitting that it did, for argument sake, it is easy to show that the *objects* of the two plans are as *different* and as *distinct* as it is possible for two plans to be; indeed, they are "wide as the poles asunder" *in principle*. To prove this, I will furnish the remainder of the specification from the "Register of Arts," and which the respectable Editor of that work affirms to be a verbatim copy. The second and third paragraphs do not, however, bear much upon the question; but, in order that I may not be charged with furnishing a garbled account, I think it best to transcribe the whole.

"When the water in the boiler," continues the specification, "is in a state of ebullition, the steam therefrom passes down the pipe *h* (the stop-cock in it being opened for that purpose), and enters the furnace through the hopper-formed grate; there ascending through the fuel, under intense ignition, it is for the most part decomposed; certain elastic gases are thus generated, which, together with the undecomposed portion of the steam, proceed along the curved pipe *i*, into the strong receiver or reservoir C. In this vessel it is kept under any required pressure by the safety-valve *j*, or other usual means for supplying the working cylinder of the engine, by a conducting pipe and cock at *k*.

"From the upper and lower parts of the water-cistern B, proceed to horizontal pipes *l l*, which enter the upper and lower parts of the boilers, preserving the water in both upon the same level, the height of which may be regulated by a float, and a force-pump is fixed at *k*, for injecting water into the cistern, to supply the loss by evaporation.

"In order to regulate the pressure of the elastic vapours in the several vessels described, a communication is opened between the reservoir C and the cistern B, by means of a short bent tube *r*, which is furnished with a stop-cock, to cut off that communication whenever required.

"In setting this apparatus to work, the cistern" (not shown in your 340th number) "and boiler should be filled up to the pipe *l*, as shown in the engraving; the apertures at the upper and lower part of the furnace opened, when ignited coke, or other fuel, is to be thrown in through the upper one (*d*), the bellows set to work, and fuel supplied at intervals, until the fire is raised to its proper intensity. When the steam has acquired the right degree of force, which is indicated by the guage, the apertures in the top and bottom of the furnace are closed by their stop-cocks, also those in pipes *f* and *r* (supposed to be previously open); the valve or cock in the tube *i* is then opened," (this is the curved tube connecting the fire chamber with the reservoir C), "along which the steam and gases pass into the reservoir C, and from thence to the engine. When the vapour has continued to pass through the furnace for a certain time, the fire becomes incapable of decomposing a further quantity; the communication with the reservoir C is therefore closed, and the fire replenished by additional fuel and the aid of the bellows while this is going forward in one of the furnaces, the other is proceeding uninterruptedly in the generation of steam and gaseous vapour, in the same manner as that already described: the pressure in the reservoir is thus, by the alternate working of the two boilers, kept under an uniform pressure, and the supply from thence to the engine rendered equable and unremitting."

After a perusal of these paragraphs, Mr. Editor, I think every one of your readers conversant with such matters will readily perceive the distinction; but we will contrast the *object* of each plan more minutely.

Gilman's Plan.

My narrative states the purpose of the described apparatus to be, to effect combustion under pressure, and to *force* the *whole* of the products arising therefrom into the water, to be evaporated.

Hall's Plan.

When "ignited coke, or other fuel, is thrown into the furnace A, through the upper aperture *d*, the bellows is set to work, and fuel supplied at intervals, until the fire is raised to the proper intensity." Now mark, Mr. Editor, De-

ring this operation the *upper* and *lower apertures* of the *furnace* are *open*, and, consequently, the *products* of *combustion escape* into the *atmosphere*.

Again, "When the fire has acquired sufficient intensity, and the steam the right degree of force, the apertures *d* and *a*, at the *top* and *bottom* of the furnace, are *closed*." *Also, and at the same time*, the communication with the *bellows* is *cut off*, by means of the cock *g* in the blast-pipe *f*," consequently, the fuel is no longer supplied with air: hence Mr. Hall *does not* use the decomposed atmospheric air *(or the nitrogen)* with the high-pressure steam, as Mr. J. Syngleman asserts, nor the *products of combustion* arising from the *decomposition* of atmospheric *air* and of *fuel*. But this is what Mr. Hall does.—After enclosing the fuel in a state of intense ignition, as just described, "the *steam* being at the right degree of force, is allowed to pass down the pipe *h* (the stop-cock being opened for that purpose), and enters the hopper-formed grate; there ascending through the fuel, under intense ignition, it is for the most *part decomposed*; certain gases are thus generated, which, together with the *undecomposed* portion of *steam*, proceed along the curved pipe *i*, into the strong reservoir C, and from thence to the working cylinder of the engine."

Now, Mr. Editor, *I force* the *products* of *combustion directly into the water*; not, however, for the purpose, or with the expectation of deriving *power* from the gases, &c. that result from the *decomposition* of the *fuel*, as is evident by my endeavour to show that there is little or no loss of power in performing the operation, but with the view to take from such gases, &c. the *heat* with which they are *supercharged*, more *readily*, more *effectually*, and in *smaller compass* than by the usual method of external application in flues.

Thus the *sole* object of the apparatus, or generator, described in my narrative, is to *secure* every *atom* of *heat possible* that is *evolved during combustion*; while Mr. Hall's *sole* object is, as he states in the commencement of his specification, and as I have proved it to be, in tracing the operation of his apparatus, to *decompose steam*, by passing it through a *mass* of *fuel* in a *state* of *intense ignition*. Hence the two objects are as different and distinct as light and darkness.

I will now conclude, Mr. Editor, by observing that these *public censors*—for so, I suppose, I must designate them—*do not* appear very remarkable either *for candour* or veracity, although they are so ready to charge others with a want of both. Of course, it must not be supposed but that they are *perfect masters* of the *subject*, otherwise they would not have *assumed* the *critic*; and, therefore, I will leave your readers to infer for what purpose Mr. J. Syngleman has omitted the *only paragraphs* that are *explanatory of the patentee's object*: why it is that he has stated "that the patentee lets in *only* a *portion* of steam *under the grate*," when the *sole object* and *purpose* of the *plan* is to pass the *whole through the fuel* and *decompose it if possible*; and, finally, why it is he states, "that Mr. Hall uses the *decomposed atmospheric air* (*or nitrogen*) with high-pressure steam," which is manifestly an untruth, as he *does no such thing*.

I am, Sir, yours, &c.

Feb. 17, 1830. WM. GILMAN.

NOTES OF DR. LARDNER'S LECTURES ON MECHANICS, AT THE LONDON UNIVERSITY.

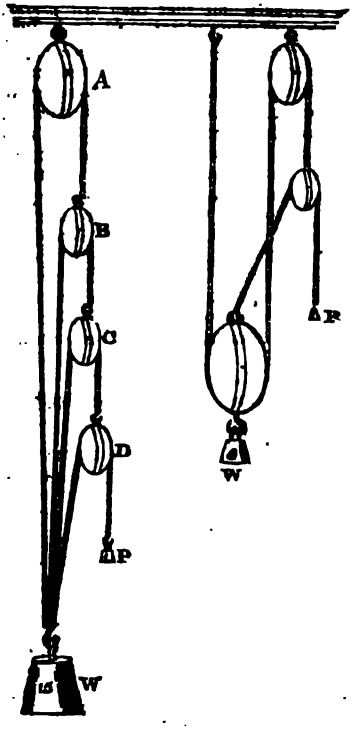
(Concluded from page 447.)

In all the last cases, the weight of the pulleys must be taken into account, which is often found to be very considerable. This inconvenience, however, is remedied in the system represented in fig. 1, where the weight of the pulleys assists the power. The proportion the weight bears to the power is thus found:—If the power be equal to 1 lb., it will bear a weight, suspended at the end of a string over the pulley D, equal to itself, or 1 lb. These two pounds together will balance a weight, suspended at the end of a string over the pulley C, equal to 2 lbs., which, added to the 1 lb. before, is equal to 3 lbs. Again, these 3 lbs., added to the power 1 lb. (viz. 4 lbs.), will balance the same weight over the pulley B, and which together with the former weight (3 lbs.) gives 7 lbs. for the weight; and thus by means of the other pulley A, may be increased to 15 lbs., which will be balanced by a power, P, equal to 1 lb. It will be plainly perceived that the pulleys here assist the power in raising the weight.

The next figure (2) is called a Spanish Burton, the power of which is to the weight as 1 to 5.

One inconvenience attending pulleys with several strings is, that the

Fig. 1. Fig. 2.



ropes are not equally stretched, as is evident from what has been already mentioned.

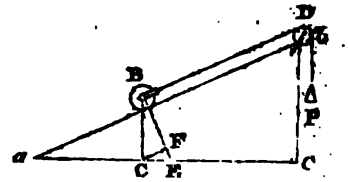
The results that would be obtained in *practice* would differ from those before given, on account of the friction which attends the number of pulleys which are used; but the investigation of the precise amount would require more mathematical science than the present Lectures will allow of.

The next class to be considered is the inclined plane, which is a plane raised at a certain angle to the horizon, or to the force intended to be resisted. If that force be gravity, it is at an angle to the horizon.

The screw and wedge are both machines of this class, but will be described hereafter.

Let fig. 3 be the inclined plane. The weight is generally applied at B, while the power acts in the direction BD, by means usually of a string BDP passing over a pulley D. The

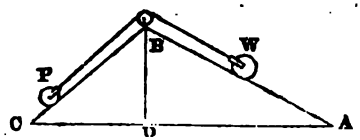
Fig. 3.



question then is, What must be the proportion between these two for them to be in equilibrium? It has been before mentioned, that three forces acting on a body will be in equilibrium where the three sides of a triangle drawn parallel to the direction of those forces are proportional to them. In this case there are three forces acting on the body B: viz. its gravity, represented by the line BC; the reaction of the plane, represented by BE at right angles to that plane; and the tension of the string, acting in the direction of the power BD, and represented by the parallel line CF: consequently, the three forces are represented by the triangle BCF; Or, what is the same thing, if the weight be in the same proportion to *ab* as the power is to *b*C, the resistance will be in the same proportion to *a*C. Thus, in any inclined plane the weight will be to the hypothenuse as the power is to the perpendicular, and as the resistance is to the base.

Two inclined planes are sometimes used, as at fig. 4; the one to support

Fig. 4.



the power, and the other the weight. Thus two inclined rail-roads are used, the power being an empty carriage descending, and the weight a full one ascending. In this case the power is to the weight as the lengths of the two planes, or P:W::AB:BC, and the pressure of the power is to that of the weight, as the bases of the two triangles, or as AD:DC, and the tension of the string will be

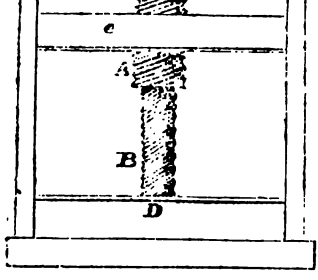
by and equal to the common perpendicular BD.

The screw, which is the next mechanical power, is only a variety of the inclined plane; a little consideration will explain this. A hill is an inclined plane, but if that hill be wound round a pillar, it will still be an inclined plane, but it has then become the variety called a screw. A straight staircase is an inclined plane, but a spiral one is a screw.

In this machine, contrary to most others, the power acts in a direction parallel to the base, and the proportion is as follows; the weight is to the power as the circumference described by the power is to the distance between the threads of the screw.

The mechanical efficacy of this machine depends upon two things; viz. the closeness of the thread, and the size of the circumference of the action of the power. In *theory* there may be no limits to the range of the power or to the fineness of the screw, but there are *practical* limits. The range of the power is limited, as in the case of the wheel and axle, by the unwieldiness of it, if very large—while the fineness of the screw is limited by its strength. There is a very ingenious machine called, from its inventor, "Hunter's Screw," represented at fig. 5.

Fig. 5.



In this case there are two screws made use of; the one, A, is a hollow cylinder, the interior of which is a nut adapted to receive the second screw B. The former one, A, *works in* a fixed nut *e*, and the other one, B, is attached to the moveable board D. When the screw A is turned once round, it advances through the nut *e*, through a space equal to the distance between two contiguous threads, and (if the screw B were not supposed to act) the board D would descend the same space. But while the screw A advances through the nut *e*, the very same revolution causes the other screw B to move downwards through a space equal to the distance between two of its contiguous threads; consequently, if the threads of the screw A be wider apart than those of B, the combined effect will be, that the board D will descend through a space equal to the difference of these intervals.

The mechanical efficacy is, therefore, increased by diminishing the difference of the distances between the threads of the screws. If the circumference described by the power be 20 inches, and one screw have 20 threads to an inch, and the other 21, the power will be to the weight as the difference between $\frac{1}{20}$ and $\frac{1}{21}$, or $\frac{1}{420}$ is to the circumference of the action of the power (20), or as 1 to 8400. If, however, one screw has 30 and the other 31 threads to an inch, then the power is to the weight as $\frac{1}{30}-\frac{1}{31}=\frac{1}{930}$ is to 20, or as 1 is to 18,600.

A screw bears this remarkable difference to other machines—that in this machine the friction assists the power; indeed, it would otherwise be useless, for it is the friction which prevents it from recoiling.

One of the most curious applications of the screw is the instrument called a micrometer, which is used for measuring small spaces. A very fine wire is divided into parts, and placed parallel to the space to be measured. This wire is moved forward by means of a fine screw, being attached to the end of it, and at the other end of which is fastened an index, against which a fixed hand acts. The index is a circle divided into 100 equal parts. A screw can easily be constructed with the distance between its threads equal to only 1-100th part of an inch; consequently, in one revolution of the screw it will be moved forward that distance, and when the index is moved one part, the screw

will only be advanced 1-100th part of that distance, or 1-10,000th part of an inch. Smeaton constructed a micrometer by which he measured a space equal to 1-60,000th part of an inch.

The next, and last power, is the wedge, which is also only a variety of the inclined plane, consisting of two inclined planes joined together, as at fig. 6. ABC is the wedge.

Fig. 6.

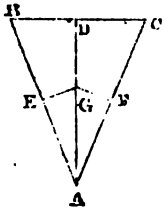
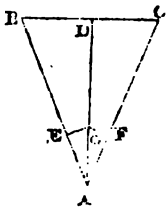


Fig. 7.



The proportion between the power and weight is found thus:—the wedge ABC may be considered as a triangle of forces, representing the power DG, and the two resistances formed by the pressures of the obstacle against the points E and F, represented by the two lines EG and FG, and which will be found, in the present instance, to be in favour of the power, and will be still more so were the resistances to act on the lower part of the wedge; which is the reason why a wedge is more effective on its being first applied to the resistance, as will be understood on inspection of the next fig. (7.) But all the *theory* of the wedge (which this is) is useless in *practice*, unless the force applied be pressure, for it is almost impossible to estimate the exact force of a blow. The only proportions that can be observed are, that the sharper the wedge is, the more powerful will it be.

S. P. W.

[It is proper to state, that the course of Lectures, our report of which is now concluded, was but a preliminary course, intended to make the student familiar with the elements of a more recondite series of Lectures on mechanical science. We may probably be able to lay the notes of the second series before our readers at some subsequent opportunity.—Ed. M. M.]

PLAN FOR ADJUSTING THE OBJECT-GLASSES OF ACHROMATIC TELESCOPES.

Sir,—It is well known that in large achromatic telescopes much difficulty is experienced in adjusting the object-glass in order to make it parallel with the eye-glasses; and should the telescope by any means be thrown out of the adjustment, it is no easy matter for any but an optician to apply the ordinary remedy.

If the following method (which I use) be thought to possess any merit, you are at liberty to insert it in your Magazine.

The cell containing the object-glass is screwed into a ring of brass about $\frac{1}{8}$ of an inch broad; this is screwed upon three small brass pillars about $\frac{1}{4}$ of an inch high. The three screws have each a square head fitting into a key. By means of this contrivance the object-glass may be placed in any position at any time, and to any degree of nicety. The adjustment is very simple, and cannot be easily thrown out without turning the screws.

I should be much obliged to any of your correspondents who would favour me with an explanation of the following singular fact. In using an astronomical telescope, I have learned that the apparent diameter of any celestial object, as seen through the telescope, differs in almost every person. In looking at Saturn, for instance, one of my friends says it appears about the size of a sixpence; a second, that it is about $1\frac{1}{2}$ inches in diameter; a third, that it is 2 inches; and a fourth, that it is $2\frac{1}{2}$ inches: while the planet does not appear to me above $\frac{1}{4}$ of an inch in diameter. In all the above cases I used a magnifying power of 75.

By attending to the above, you will gratify and oblige,

Yours respectfully,

John Holyman.
(A Constant Reader.)

176, *Old Gravel-lane*,
Feb. 19, 1830.

ARITHMETICAL QUESTION.

Sir,—In problem 11, p. 79, of Sir Isaac Newton's "Universal Arithmetic," the following question is proposed:—

"If the number of oxen a eat up a meadow b in the time c; and the number of oxen d eat up as good a piece of pasture e in the time f: and the grass grow uniformly. To find how many oxen will eat up the like pasture g in the time h."

Sir Isaac Newton solves the problem, and finds that the meadow g will suffice to feed the oxen, $\frac{bdfgh - acegh - bdcfg + acefg}{befh - bceh}$ during the time h.

Sir Isaac then proposes the following arithmetical question:—

"If 12 oxen eat up 3½ acres of pasture in 4 weeks, and 21 oxen eat up 10 acres of like pasture in 9 weeks. To find how many oxen will eat up 24 acres in 18 weeks, the growth of the grass being uniform."

He gives an arithmetical solution of this question independent of the above formula. But, Mr. Editor, I must confess I cannot rightly comprehend either the one or other. True, Sir Isaac did not write for the information of numskulls, to which class I must confess I am a kinsman. If, therefore, any of your scientific contributors (and you have some known ones), would be so kind as to give such solutions for the above questions as might be understood by the unfortunate class of which I am a member, they will much oblige,

Your humble servant,

H. T.

P. S.—I return my best thanks to your ingenious correspondents, P. M. W., and G. S., for their plain investigations of the rule for finding the area of a curvilineal space by the method of equidistant ordinates.

CAST-IRON BRESTSUMMERS.

Sir,—Having ventured, with a good intention, to allude to the *possibility* of cast-iron brestsummers being broken in the event of fire, and not being discouraged by the observation which was made upon it, I again venture to call your attention to another circumstance, which will, I think, prove that cast-iron is not to be depended upon in such applications, without some further protection.

At the late fire in the Argyll-rooms, several cast-iron pillars, about three inches in diameter and twelve feet long, on becoming heated, were bent by the load which they had to support to a curve about one foot from their original right line.

Now if cast-iron pillars, by being heated, are thus bent by their load, it becomes, I think, not only a *possibility*, but a *certainty*, that brestsummers, strained transversely, will, when heated, be bent by their load, and that mischief may result in this way from them, or from cast-iron joists, lintels, roofing, &c. The effect of heat on the strength of wrought-iron ought also to be considered.

The protection required is a casing, or other means of preventing the heat from getting to the pillars, brestsummers, &c.

I remain, Sir, yours, &c.

J. S. S.

INTERIM NOTICES.

The Supplement to Volume XII. which it was announced would be published along with the present Number, is, in consequence of a delay on the part of the Engraver, not yet ready. We hope to be able to publish it next week.

Communications received from W. H. B.—S. Y.—Messrs. Burns—Jonathan Dawplucker—P. P.—G. F. M.—A Student—Caveto.

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TYPOGRAPHICAL ERRORS IN VOL. XII.

Page 4, column 1, line 26, for "rous-soirs," read "*voussoirs.*"

Page 34, column 1, line 8 from the bottom, for "pins," read "piers."

Ibid. line 5 from the bottom, for "piles," read "piers."

Page 53, the wood-cut at the bottom of this page should have exchanged places with that near the top of p. 54.

Page 55, column 2, line 1, for "A, B, 4, D," read "A, B, C, D."

Ibid. column 2, line 2, for "D 4," read "D C."

Ibid. 5th line from the end of the article by G. S., for "104·7197126+12," read "104·7197126×12."

Page 96, column 2, line 20, for "absorption," read "compression."

Page 98, column 1, line 13 from the bottom, for "piles," read "piers."

Page 100, line 18 from the end of the article on the bridges over the Thames, for "piles 20 feet in thickness," read "piers 20 feet in thickness."

Page 146, column 1, line 28, for "Liverpool Mercury" read "Liverpool Chronicle."

Page 165, where the cost of "The Novelty" for fuel is stated to be "one farthing" per mile, read "one halfpenny."

Page 205, column 1, line 8, for "B^2, read "B E."

Ibid. column 1, lines 9 and 10, for "60^2," read "D C^2."

Page 224, column 2, line 17, for "Map," read "Essays."

Page 252, column 1, line 14 from the bottom, for "corner parts," read "upper parts."

Page 258, column 2, line 38, for "experiment," read "expedient."

Page 260, column 1, line 19, for "the nitrogen thus charged with heat," read "the heat thus absorbed by the nitrogen."

Page 279, column 1, line 25, for "3," read "4;" and for "has," read "have."

Ibid. line 35, for "4," read "5."

Ibid. column 2, line 10 from the bottom, for "Lecroix," read "Lacroix."

Page 294, column 1, line 19, for "p. 6," read "p. 5."

Ibid. column 2, line 14, for "hours," read "three hours."

Page 295, column 2, line 7, for "at Weymouth, 5h. 30m.," read "at Weymouth, 6h. 30m."

Page 299, column 1, line 14, for "$x^4 - 9x^3 + 6x - x = 1590$," read "$x^4 - 9x^3 + 6x^2 - x = 1590$."

Page 307, column 1, line 20, for 'Vaaloue," read "Vaulque."

Page 310, column 1, line 28-29, for "annalyst," read "analyst."

Ibid. column 1, line 40, for "alip," read "skip."

Ibid. column 1, lines 46-47, for "he cannot bring any one of his modifications to accord with," read "he cannot bring more than one of his modifications to an obvious comparison with."

Page 310, column 2, line 33, for "varies," read "so varies."

Ibid. column 2, line 43, for "verily," read "vastly."

Page 311, column 1, line 16, after "diameter," add "declinations."

Page 312, column 1, line 15 from the bottom, for "practical," read "physical."

Ibid. column 1, line 10 from the bottom, for $\frac{m' P^3}{m' P^3}$, read $\frac{m P^3}{m' P^3}$.

Page 319, column 2, line 6 from the bottom, for "geometric," read "geocentric."

Page 359, in the answer to the second, third, and last queries, for "the *slope* of the pipe," read "the *length*."

Ibid. line 27, for "$\sqrt{s+1\cdot6}$)," read "$\sqrt{(s+1\cdot6)}$)."

P. 421, column 2, line 14, for "$\frac{(1+m)A}{A+B}(a-b)$" &c. read "$\frac{(1+m)A}{A+B+b}$)."

Same column, 6th line from the bottom, after "new form" add "is also."

P. 422, column 2, line 16, for "M and BV," read "M=BV;" and for "M moving force, B mass," read "M=moving force, B=mass."

Page 423, the article entitled "Cylindrical Railway-carriage" was previously inserted, p. 323.

Page 441, column 2, line 5, for "prism," read "mirror."

Page 479, column 2, line 23, after "three small brass pillars about $\frac{1}{4}$ of an inch high," add "on each of which is a spiral spring."

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